# MW32 WELL INSTALLATION AND SAMPLING REPORT
# OMEGA CHEMICAL CORPORATION SUPERFUND SITE

LOS ANGELES COUNTY, CALIFORNIA

EPA CONTRACT NO. EP-S9-08-04
EPA WORK ASSIGNMENT NO. 038-RICO-09BC
CH2M HILL PROJECT NO. 386743

Prepared for
U.S. Environmental Protection Agency
Region 9
75 Hawthorne Street
San Francisco, California 94105

Prepared by
CH2M HILL
1770 Iowa Avenue, Suite 200
Riverside, California 92501

August 2012

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NONDISCLOSURE STATEMENT

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# Acronyms and Abbreviations

| | |
|---|---|
| µg/L | microgram(s) per liter |
| °C | degree(s) Celsius |
| 1,2,3-TCP | 1,2,3-trichloropropane |
| AMK | former Angeles Chemical Company and former McKesson Corporation |
| amsl | above mean sea level |
| ASTM | ASTM International |
| bgs | below ground surface |
| CERCLIS | Comprehensive Environmental Response, Compensation, and Liability Information System |
| CLP | Contract Laboratory Program |
| COC | chain-of-custody |
| DO | dissolved oxygen |
| DQO | data quality objective |
| EPA | United States Environmental Protection Agency |
| F11 | trichlorofluoromethane [Freon 11] |
| F113 | 1,1,2-trichloro-1,2,2-trifluoroethane [Freon 113] |
| F12 | dichlorodifluoromethane [Freon 12] |
| FS | feasibility study |
| FSP | field sampling plan |
| gpm | gallon(s) per minute |
| GSWC | Golden State Water Company |
| GWF | general well function |
| IDW | investigation-derived waste |
| MEK | methyl ethyl ketone |
| mg/kg | milligram(s) per kilogram |
| mL | milliliter(s) |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| NAD83 | North American Datum of 1983 |

| | |
|---|---|
| NAVD88 | North American Vertical Datum of 1988 |
| ND | non-detect |
| NPL | National Priorities List |
| NTU | nephelometric turbidity unit |
| Omega | Omega Chemical Corporation |
| Omega Site | Omega Chemical Corporation Superfund Site |
| OPOG | Omega Chemical Site PRP Organized Group |
| ORP | oxidation-reduction potential |
| OSVOG | Omega Small Volume Group |
| OU | operable unit |
| PCE | perchloroethylene (tetrachloroethylene) |
| PID | photoionization detector |
| PRP | potentially responsible party |
| PVC | polyvinyl chloride |
| QA | quality assurance |
| QAO | Quality Assurance Office |
| QAPP | Quality Assurance Project Plan |
| QC | quality control |
| RCRA | Resource Conservation and Recovery Act of 1978 |
| RI | remedial investigation |
| RPD | relative percent difference |
| RI/FS | remedial investigation/feasibility study |
| SAP | sampling and analysis plan |
| SB | stratigraphic boundary |
| TCE | trichloroethene |
| THM | trihalomethane |
| TOC | total organic carbon |
| USA | Underground Service Alert |
| USCS | Unified Soil Classification System |
| VOC | volatile organic compound |
| Weston | Weston Solutions, Inc. |

# 1. Introduction

This report summarizes the installation and sampling of groundwater monitoring well MW32 by CH2M HILL for Operable Unit (OU) 2 of the Omega Chemical Corporation Superfund Site (Omega Site or Site; Figure 1-1). MW32 was installed and sampled in accordance with Sampling and Analysis Plan (SAP) Addendum 7 (CH2M HILL, 2012a), prepared to support the United States Environmental Protection Agency (EPA) in performing ongoing work to improve characterization of the commingled contaminant plume in groundwater at OU2.

SAP Addendum 7 is a supplement to the field sampling plan (FSP), *Field Sampling Plan for Omega Chemical Superfund Site Operable Unit 2 Remedial Investigation/Feasibility Study, Addendum 1* (CH2M HILL, 2006a) and *Quality Assurance Project Plan (QAPP) for Omega Chemical Superfund Site Operable Unit 2 Remedial Investigation/Feasibility Study, Addendum 1* (CH2M HILL, 2006b). Addendum 1 was prepared to supplement the 2004 SAP (CH2M HILL, 2004a and 2004b).

The objectives and scope of work for the installation and sampling of MW32 were developed using EPA's seven-step data quality objective (DQO) process. The DQOs are presented in SAP Addendum 7. The project background, objectives, and scope of work for the installation and sampling of MW32 are described in this section, followed by an overview of the organization of the rest of this report. A detailed description of the work performed is provided in Section 2, the results are provided in Section 3, a summary is provided in Section 4, and references are provided in Section 5.

## 1.1 Background

This section summarizes the operational history of the Omega facility and the past investigation and remediation activities conducted at the Omega Site. Detailed discussions regarding the Omega Site are provided in the Final Remedial Investigation (RI) Report for the site (CH2M HILL, 2010). The Site is located in Los Angeles County, California (Comprehensive Environmental Response, Compensation, and Liability Information System [CERCLIS] ID No. CAD042245001).

Omega is a former refrigerant/solvent recycling operation located in Whittier, California, a community of approximately 85,000 people. The Omega property occupies Los Angeles County Assessor Tract Number 13486 (Lots 3 and 4). It covers an area of approximately 41,000 square feet (200 feet wide by 205 feet long) and contains two structures—a 140- by 50-foot warehouse and an 80- by 30-foot administrative building. The Omega property is paved with concrete and secured with a 7-foot-high perimeter fence with a locking gate and topped with razor wire. The facility operated as a Resource Conservation and Recovery Act of 1978 (RCRA) solvent and refrigerant recycling and treatment facility from approximately 1976 to 1991, handling primarily chlorinated hydrocarbons and chlorofluorocarbons. Drums and bulk loads of waste solvents and chemicals from various industrial activities were processed at the former Omega facility to form commercial products. Chemical, thermal,

and physical treatment processes were reportedly used to recycle the waste materials. Wastes generated from these treatment and recycling activities included distillation column (still) bottoms, aqueous fractions, and non-recoverable solvents. Prior to constructing the buildings at the Omega property in July 1951, the property was used for agriculture.

The Omega Site was placed on the National Priorities List (NPL) in January 1999. EPA currently manages the Omega Site as three OUs (OU1, OU2, and OU3). A site map showing the approximate boundary of OU2 is presented in Figure 1-2.

- OU1 includes the soil and groundwater contamination at the former Omega facility, located at 12504 and 12512 East Whittier Boulevard, and approximately 100 feet west-southwest of Putnam Street.
- OU2 generally includes the groundwater-contaminated area that extends from the former Omega facility to approximately 4.5 miles south-southwest of the site, much of which has commingled with chemicals released at other areas overlying the OU2 groundwater plume.
- OU3 addresses indoor air impacts at the former Omega property, as well as adjacent and nearby properties where the underlying vadose zone has been affected by contamination derived from the former Omega property.

Groundwater at the Omega Site is found to be primarily affected by volatile organic compounds (VOCs). Chlorinated hydrocarbons (e.g., tetrachloroethylene [PCE], trichloroethene [TCE], and others), freons (trichlorofluoromethane [F11] and 1,1,2-trichloro-1,2,2-trifluoroethane [F113]), and emergent compound 1,4-dioxane are among the contaminants with the highest concentrations.

A Remedial Investigation/Feasibility Study (RI/FS) was completed for the OU2 plume by CH2M HILL on behalf of EPA (CH2M HILL, 2010). Site investigation at Omega OU2 was started in 2001 by Weston Solutions, Inc. (Weston) on behalf of EPA. Weston performed OU2 investigations in 2001 to 2002 and prepared two groundwater characterization reports (Weston, 2002 and 2003). The Omega Small Volume Group (OSVOG) installed groundwater monitoring wells at OU2 in 2005 and 2006 (ARCADIS, 2007). CH2M HILL continued the OU2 site investigation on behalf of EPA and completed the RI for OU2 in 2010. The RI report describes in detail the investigation activities and major findings from these activities. In addition, routine groundwater monitoring is being performed for the OU2 plume. The most-recent results are provided in a report documenting the monitoring performed during 2010 and 2011 (CH2M HILL, 2012b).

VOCs have been found in groundwater extracted from Golden State Water Company (GSWC) production wells Pioneer 1, Pioneer 2, and Pioneer 3 located near the southwestern edge of the OU2 plume (Figure 1-2). The Pioneer wells are screened at approximately 200 feet below ground surface (bgs) (short screens). The depth extent of the VOC contamination in this area of OU2 is uncertain.

## 1.2 Objectives

The objectives of this investigation are as follows:

- Confirm the continuity of VOC contamination between the currently identified OU2 groundwater plume and the Pioneer production wells
- Assess the depth extent of VOC contamination upgradient of the Pioneer production wells
- Provide a permanent well location for ongoing groundwater monitoring between the currently identified OU2 groundwater plume and the Pioneer production wells

## 1.3 Scope of Work

One deep groundwater monitoring well (MW32) was installed and sampled north/ northeast (upgradient) of the Pioneer production wells along Pioneer Boulevard in Norwalk, California, to meet the objectives outlined above (Figure 1-2). MW32 will be included in the routine groundwater monitoring program. The following field and laboratory activities were performed during the installation and sampling of MW32:

- Drilled and continuous cored to a depth of 250 feet bgs
- Collected discrete-depth groundwater samples at 10-foot intervals during drilling
- Constructed MW32 with a screened interval from 163 to 178 feet bgs
- Ran a geophysical log in the constructed well (natural gamma and conductivity)
- Developed the well, performed a short-term pumping test, and collected a bulk groundwater sample from the wellhead
- Analyzed soil core samples for total organic carbon (TOC)
- Analyzed the discrete-depth and bulk groundwater samples for VOCs and 1,4-dioxane
- Validated and performed a data quality assessment for the laboratory data
- Managed, sampled, analyzed, and disposed of investigation-derived waste (IDW)

## 1.4 Report Organization

The remainder of this report is organized as follows:

- Section 2 describes the field and laboratory investigation work performed.
- Section 3 provides the results of the field and laboratory investigation work.
- Section 4 provides a summary of findings.
- Section 5 lists the references.

Much of the information presented is included in tables, figures, and appendices referenced in the text.

The appendixes to this document include the following:

A Encroachment and Well Construction Permits (on CD only)
B Boring Log and Soil Core Photographs
C Well Construction Diagram
D Well Survey Report (on CD only)
E Downhole Geophysical Log (on CD only)
F Well Development Log (on CD only)
G Well Pumping Test Log (on CD only)
H Chain of Custody Forms (on CD only)
I Laboratory Reports (on CD only)
J Data Validation (on CD only)
K Pumping Test Analysis
L IDW Shipment Manifest (on CD only)

# 2. Field and Laboratory Methods

This section describes the field and laboratory work performed to install and sample MW32. This work was performed in accordance with SAP 7, described in Section 1.

## 2.1 Pre-Field Activities

CH2M HILL performed the following work prior to commencing field activities:

- A site walk was conducted on April 8, 2012, to check for access, overhead clearance, potential traffic issues, and mark the proposed boring location.
- Underground Service Alert (USA) was notified to mark out buried utilities.
- A surface geophysical survey was performed on April 8, 2012, to screen the planned drilling location for potential underground utilities or buried objects. The survey was performed by Spectrum Geophysics under subcontract to CH2M HILL.
- Excavation and encroachment permits were obtained from the City of Norwalk. Copies of the permits are included in Appendix A.
- A well construction permit was obtained from the County of Los Angeles Department of Public Health – Environmental Health Division. A copy of the permit is included in Appendix A.

## 2.2 Drilling and Coring

Drilling and continuous coring were performed from April 23 to April 30, 2012, using Sonic drilling methods by Cascade Drilling, L.P. under subcontract to CH2M HILL. Drilling was performed by telescoping with 6-, 7-, 8-, and 9.625-inch-outside-diameter drill pipe to successfully reach the desired depth of 250 feet bgs. Soil cores were retrieved using a 10-foot-long, 6-inch-diameter core barrel. Prior to drilling, the well location was hand-augured to 10 feet bgs to check for the presence of subsurface obstructions.

Soil core samples were screened for organic contaminants with a calibrated photoionization detector (PID). The lithology was described by the Unified Soil Classification System (USCS) in accordance with ASTM International (ASTM) D2488-84. Photographs were taken of the cores. A boring log with the PID readings and lithology descriptions and core photographs are provided in Appendix B.

A total of 10 soil samples with 1 duplicate were collected from the core and sent to a laboratory for analysis of TOC content. The samples were collected from both coarse- and fine-grained units to provide characterization of both aquifers and aquitards, respectively. The samples were collected directly into 8-ounce glass jars and cooled to 4 degrees Celsius (°C) prior to shipment to the laboratory.

## 2.3 Discrete-depth Groundwater Sample Collection

Discrete-depth groundwater samples were collected during drilling using direct-push methods (i.e., Hydropunch). Samples were collected at approximately 10-foot intervals from 110 to 250 feet bgs, beginning at the water table to the total borehole depth. A total of 15 samples with 1 duplicate were collected over this interval.

The sampling rods were pushed ahead of the drill bit to avoid volatilization of VOCs. The samples were collected through the push-rods using a stainless-steel bailer suspended on a string, deployed, and retrieved by hand. The water was decanted from the bailer into 40-milliliter (mL) pre-preserved vials ensuring a zero headspace. The vials were capped and checked for air bubbles and stored (and shipped) cooled to 4°C.

Quality assurance/quality control (QA/QC) samples included the one field duplicate sample (collected for the 120 foot sample) and an equipment blank. Extra volume for matrix spike/matrix spike duplicates (MS/MSDs) was not collected because these were screening samples. The equipment blank was collected after the first Hydropunch sample at 130 feet to ensure that equipment was properly decontaminated after passing through shallow groundwater that was expected to have high VOC concentrations.

## 2.4 Well Construction and Geophysical Logging

MW32 was constructed using 3-inch-diameter, flush-threaded Schedule 80 polyvinyl chloride (PVC) casing and 3-inch-diameter (0.02-inch slot) PVC well screen. The screen interval was 15 feet long extending from 163 to 178 feet bgs. A 5-foot PVC sediment trap with end cap was installed below the screen for a total well depth of 183 feet bgs. Centralizers were used above and below the well screen and every 40 feet above the screen. A 1-inch-diameter piezometer (MW32P) was screened from 80 to 100 feet bgs into the annular space of MW32 to monitor the water table. The boring was subsequently backfilled with bentonite pellets from 250 to 183 feet bgs. A #3 sand filter pack was installed from 183 to 160 feet bgs followed by a finer-grained #30 transition sand from 160 to 158 feet bgs. Bentonite pellets were then placed from 158 to 102 feet bgs. Following the transition seal installation of bentonite pellets, a #3 filter pack sand was installed across the MW32P screen from 102 to 77 feet bgs. A #30 transition sand was placed from 77 to 75.5 feet bgs, followed by a bentonite transition seal from 75.5 to 70 feet bgs. A cement-bentonite grout (Portland Type II cement and Aquaseal) was emplaced by tremie as the annular seal from 70 feet bgs to ground surface. A 30-minute waiting period occurred between hydrating the bentonite seal and installing the cement-bentonite grout seal. All annular materials were tremied through the annular space between the casing and inner wall of the sonic drill pipe. The surface was completed using a flush-mount, traffic-rated well vault set in concrete and secured with bolts. A well construction diagram of MW32 is provided in Appendix C.

The location (northing and easting coordinates), ground surface elevation, and top of casing elevation for well MW32 were surveyed by Calvada under subcontract to CH2M HILL. Horizontal coordinates were surveyed using the North American Datum of 1983 (NAD 83) and vertical elevation using North American Vertical Datum of 1988 (NAVD 88). A copy of the survey report is provided in Appendix D.

Natural gamma ray and conductivity geophysical logs were run in MW32 after construction to provide geophysical data for the surrounding formation. The logs were run by Pacific Surveys under subcontract to CH2M HILL. The well log is provided in Appendix E.

## 2.5 Well Development, Pumping Test, and Sampling

Following construction, MW32 was developed using a combination of airlifting, swabbing, bailing, and pumping. Before removal of the groundwater, a bailer was used to remove fines that entered the well. Development activities commenced on May 7, 2012, 2 days after the well was constructed. Well development continued until turbidity reached < 5 nephelometric turbidity units (NTUs). A copy of the well development logs is provided in Appendix F.

A short-term pumping test was conducted for MW32, after it was developed, to estimate aquifer properties and collect a groundwater sample. The pumping test consisted of pumping at different discharge rates (2.0, 2.5, 3.0, 3.5, 3.7, and 4.0 gallons per minute [gpm]) at 10-minute intervals until groundwater in MW32 reached maximum drawdown possible with the pump provided. At the termination of pumping, the well was left undisturbed for 30 minutes to monitor recovery of groundwater into the well. Depth to water measurements were collected using an In Situ Inc. Level TROLL 700 pressure transducer deployed in the well to collect accurate real-time data. A copy of the pumping test log is provided in Appendix G, as well as the pressure transducer data collected.

A groundwater sample was collected at the conclusion of the short-term pumping test. The sample was collected at ground surface from the pump discharge line. The water was diverted into 40-mL pre-preserved vials ensuring a zero headspace. The vials were capped and checked for air bubbles and stored (and shipped) cooled to 4°C.

A digital combination conductivity-pH-temperature-dissolved oxygen (DO)-oxidation-reduction potential (ORP) meter was used to measure specific conductance, pH, temperature, DO, and ORP during well development, the pumping test, and sampling. Turbidity measurements were made with a digital readout turbidity meter (readout in NTUs). A PID was used to measure organic vapor measurements (headspace) inside the well immediately after opening the well caps. Equipment used to measure field parameters was maintained and calibrated daily according to the manufacturer's specifications.

Depth to groundwater was measured immediately prior to well purging and sampling activities to establish a static water level. Water levels were measured during purging activities during development and the pumping test. The measurements were made with a decontaminated electronic water level indicator (sounder) to the nearest 0.01 foot.

## 2.6 Quality Assurance/Quality Control

QA/QC samples were collected in accordance with the protocols outlined in the FSP and QAPP with a few deviations. QC samples include equipment blanks, field duplicates, and temperature blanks. Ambient blanks and laboratory QC samples (for MS/MSDs) were not collected from samples during drilling operations because the samples were for screening purposes only. An ambient blank and laboratory QC sample were not collected for the post-

development sample, which was collected by standard purge methods for baseline well screening. Future sampling by low-flow purge methods will include the standard QC collection within the monitoring well program. An equipment blank was collected between Hydropunch sampling to confirm that decontamination was properly performed between sample depths. An equipment blank was not collected for the post-development groundwater sample because multiple depth sampling with potential for cross contamination was not performed. The equipment blank was analyzed for VOCs and 1,2,3-trichloropropane (1,2,3-TCP). Field duplicates were analyzed for the standard list of parameters as presented in Section 2.2.

## 2.7 Laboratory Analysis of Soil and Groundwater Samples

Soil, groundwater, and IDW samples were shipped under chain of custody procedures and analyzed as follows:

- The Hydropunch and post-development groundwater well sample were analyzed for VOCs and 1,4-dioxane under the EPA Contract Laboratory Program by A4 SCIENTIFIC, INC., located in The Woodlands, Texas.
- Soil samples were analyzed for TOC by the Walkley-Black method by APPL Inc. located in Clovis, California, under subcontract to CH2M HILL.
- IDW samples were analyzed for metals by EPA 6000/7000 and EPA 200, hexavalent chromium by EPA 218.6, extractable and purgeable petroleum hydrocarbons by EPA 8015C, and VOCs by EPA 8260C by EPA Region 9 Laboratory in Richmond, California.

Chain-of-custody (COC) forms are provided in Appendix H and laboratory reports are provided in Appendix I.

## 2.8 Data Review and Validation

The depth-specific and post-development groundwater samples were reviewed for all analytical parameters, detects, and nondetects at Tier 2, per the regional EPA Quality Assurance Office (QAO) guidance. The post-development groundwater samples were also reviewed at Tier 3 for all parameters, detects, and nondetects. The Tier 3 review was performed by the EPA Regional QAO (Tier 3 validation per regional guidance). The TOC data did not undergo review outside of the laboratory that performed the analysis; however, the QA/QC section of the TOC data are provided within the laboratory report of Appendix I. Data validation flags were assigned to the analytical results as determined by these data reviews.

## 2.9 Pumping Test Analysis

The pumping test data collected with the Level TROLL 700 pressure transducer were saved as ASCII files and pre-processed in Microsoft Excel. The data were analyzed in AQTESOLV with the Moench method (Moench, 1997) and with the general well function (GWF) method (Perina and Lee, 2006). The recorded data and fit curves are presented in Appendix K.

## 2.10 IDW Management, Sampling, and Disposal

IDW generated during this field investigation included solids and liquids. Solids include soil cuttings from drilling and soil sampling activities. Liquid waste includes decontaminant rinsate water, well development water, groundwater sampling purge water, and pumping test purge water. Analytical profiling samples were collected for both matrixes and submitted to the EPA Region 9 Laboratory for analysis. Laboratory reports are provided in Appendix I as stated in Section 2.7 of this report.

The drill cuttings were segregated from liquid waste at MW32 and stored in a plastic-lined, 20-cubic-yard roll-off bin. The liquid waste (decontamination, well development, and purge water) was stored onsite in a Baker tank designed to store liquid.

Clean Harbor Environmental Services was retained as the subcontractor to Cascade Drilling for the storage and removal of waste. Solid waste was transported under nonhazardous manifest to the Crosby and Overton waste management facility in Long Beach, California, while liquid waste was transported under nonhazardous manifest to Clean Harbors Buttonwillow facility in Buttonwillow, California. The waste profiles and manifests are included in Appendix L.

# 3. Results and Discussion

This section provides and discusses the results of the field and laboratory work described in Section 2. The lithology, aquifer units, and aquifer parameters are discussed in context of the hydrogeology presented in Section 4.5 of the RI Report (CH2M HILL, 2010). Figure 3-1 presents a summary of the lithology and select VOCs (TCE, PCE, F113, and 1,4-dioxane) that were encountered during the drilling and installation of MW32.

## 3.1 Lithology, Stratigraphic Units, and Aquifer Parameters

### 3.1.1 Lithology

A series of fine-grained (silt/clay) and coarse-grained (sands) materials were encountered throughout the depth of the boring (see the boring log in Appendix B). A total of five prominent sand intervals were encountered as shown in Figure 3-1. The lithology encountered at MW32 is generally consistent with the lithology reported in nearby wells within OU2 (CH2M HILL, 2010).

Near-surface soils at MW32 consist of sands and silts that are of various shades of brown, from light olive to yellowish. Olive brown to dark greenish gray, poorly to well-graded sands with intervening light olive brown sands are present below 160 feet at MW32. The sands are fine to coarse, with occasional gravels. Clasts are largely subrounded, and of granitic origin. The fine-grained soils found at MW32 are olive brown to greenish gray silts and clays.

### 3.1.2 Stratigraphic Units

The lithologic and stratigraphic model for OU2 is illustrated by cross sections AA', BB', and CC' (Figure 4-7) in the RI Report (CH2M HILL, 2010). Sections AA' and CC' are oriented sub-parallel, and BB' is oriented perpendicular to the major groundwater flow direction. Eight stratigraphic boundaries (SBs) have been defined for OU2 as shown in these sections. These boundaries separate stratigraphic units and some of them may represent depositional sequence boundaries. The SBs are numbered sequentially from the top, starting with SB1 corresponding to the base of Holocene deposits; similarly, SBs 2 to 7 correspond to the Pleistocene deposits.

The installed piezometer MW32P is screened across the water table from 80 to 100 feet bgs, which was the first significant sand unit that was saturated. The water table is within the first saturated sandy unit which appears to be above SB3, based on hydrostratigraphic interpretations in Figure 4-7 of the RI Report.

The screened interval of MW32 from 163 to 178 feet bgs is within poorly graded sands and gravels that extend between 150 and 180 feet bgs and are underlain by a 9-foot-thick clayey unit. The sand-clay interface at 180 feet bgs may correlate with SB3 based on hydrostratigraphic interpretations in Figure 4-7 of the RI Report. The units dip generally to the southwest in the area between wells MW27 and MW29, which are located at the

southwestern flank of the northwest plunging Santa Fe Springs anticline. MW32 is located about 0.4 mile to the west of section CC' (in down-dip direction).

Driller's logs for the Pioneer 1, Pioneer 2, and Pioneer 3 production wells indicate predominantly sands and gravels with occasional intervening clay units between depths of 140 and 220 feet bgs. The Pioneer wells are located about 0.16 mile southwest of MW32. It is possible that the coarse-grained units are continuous between MW32 and the Pioneer wells. The three Pioneer wells have short (approximately 20 feet) screens with top of screen above and bottom of screen below 200 feet bgs; Pioneer 3 has a second screen interval at a depth greater than 400 feet bgs. The Pioneer wells and MW32 could be screened in hydraulically connected units. Stratigraphic correlation between the lithologic profiles at the Pioneer wells and MW32 was not attempted.

### 3.1.3 Aquifer Parameters

A table of the pumping test data and calculations are located in Appendix K. The pumping test data were analyzed by the Moench (1997) and GWF (Perina and Lee, 2006) methods for pumping well drawdown. Both methods account for horizontal to vertical aquifer anisotropy, wellbore storage, well skin, and partial penetration of the aquifer thickness. Fitting of measured drawdown by both methods used the Marquardt-Levenberg (Marquardt, 1963) least squares method.

The estimated aquifer parameters included transmissivity (T) and storativity (S) for the Moench method and horizontal hydraulic conductivity (K) and specific storage ($S_s$) for the GWF method. K describes the ease with which water can move through porous media (soil or rock). T equals K multiplied by the aquifer thickness and therefore describes the ease with which water can move through the aquifer. $S_s$ is related to the capacity of an aquifer to release groundwater from storage in response to a decline in hydraulic head (or pressure). S equals $S_s$ multiplied by the aquifer thickness. K, T, $S_s$, and S are calculated for the sandy interval between 150 and 180 feet bgs (Sand 4, Figure 3-1) over which MW32 is screened (163 to 178 feet bgs). The assumed aquifer thickness is 30 feet, which is the thickness of Sand 4.

The recorded drawdown data are noisy due to the wear of the pump used. The pump was unable to achieve a discharge rate greater than 4 gpm. Because of the low discharge rate, the drawdown during the test was not affected by frictional well loss.

The analysis assumed that the aquifer responded as an ideal confined aquifer. This is a reasonable assumption for the short duration of the test. Longer pumping would likely induce leakage from overlying and underlying layers which would complicate the analysis. Aquifer heterogeneity away from the test well could also affect longer pumping. These effects could not be quantitatively evaluated from pumping well data alone. For these reasons, a short test duration was adequate.

The parameters calculated by the Moench method in AQTESOLV were T = 5753.4 square feet per day and S = 0.1. These values correspond to $K_r$ = 192 feet per day and $S_s = 3.3 \times 10^{-3}$ per foot. The parameters calculated by GWF method were $K_r$ = 136 feet per day; and $S_s = 6.73 \times 10^{-5}$ per foot. The relative percent difference (RPD) was calculated for each of the corresponding parameters between the two methods to compare the results. RPDs for $K_r$ and $S_s$ were 9 and 48 percent, respectively.

The $K_r$ values are a reasonable estimate for the pumping test based on the sandy material screened by MW32. The RPD range for $K_r$ is well within the overall uncertainty of the analyses considering the data noise and variability associated with pumping variation by equipment wear. The $S_s$ values estimated by the GWF method are physically plausible while the estimates from the Moench method are considered too high. However, the reliability of $S_s$ values calculated only from pumping well data are considered to be relatively low and data from observation wells would be needed for more accurate estimation of $S_s$. The calculation of $S_s$ from the MW32 pumping test data is opportunistic and should only be used as an order-of-magnitude estimate.

## 3.2 Groundwater Levels

Depth to water measurements in MW32 and MW32P were collected during well development activities and following completion of the pumping test. They were collected to determine groundwater elevations at MW32 and to help characterize water level differences between the shallow and deep aquifers. Groundwater elevations were calculated by subtracting the depth to static water level from the elevation of the reference point (i.e., the surveyed top of casing elevation of the corresponding monitoring wells). The reference point elevations for EPA wells are the NAVD88 (2000 adjusted) datum.

Table 3-1 presents the depth-to-water measured in the field and the calculated groundwater elevations at MW32 and MW32P. The calculated groundwater elevation for MW32P is 33.39 feet above mean sea level (amsl) and for MW32 is 29.90 feet amsl, indicating a downward groundwater gradient. The difference in groundwater elevation was 3.49 feet. The groundwater elevations at MW32 and downward gradient are generally consistent with the overall groundwater levels observed from previous OU2 monitoring events (CH2M HILL, 2011, 2012b).

## 3.3 Analytical Results

This section presents the analytical results of the MW32 screening samples from discrete-depth hydropunches during drilling, soil samples from select coarse- and fine-grained soil units, and post development groundwater samples from the MW32 well. Table 3-2 presents the detected VOCs and 1,4-dioxane for the depth-specific and post-development groundwater samples. Table 3-3 presents the TOC data for the soil samples. Appendix I presents the laboratory analytical reports, which include the non-detects (NDs). Appendix I also includes summary tables for QC samples.

### 3.3.1 Depth-Specific Groundwater Samples

VOCs were detected in all depth-specific groundwater samples (Table 3-2). The concentrations of TCE, PCE, F113, 1,4-dioxane that are used to track VOCs from the Omega site generally display an overall trend of decreasing contaminant concentrations with depth (Figure 3-1). TCE and PCE concentrations decrease to below 5 micrograms per liter (µg/L) and F113 was not detected below the screened interval of MW32. The decrease in these VOC concentrations with depth is consistent with the decrease that has been documented in previous investigations (CH2M HILL, 2010, 2011, and 2012b). The fine-grained (clayey)

layer below 180 feet bgs is likely a barrier to contaminant transport. The VOCs detected in samples below 180 feet bgs could indicate cross-contamination during drilling (VOCs migrating downward along the borehole during drilling).

PCE was detected in all depth-specific samples except for the sample taken from 230 ft bgs. PCE concentrations ranged from 0.38 J µg/L to 28 µg/L. TCE was detected in all samples and ranged from 0.49 J to 18 µg/L. F11 was detected in the samples from 140, 160, and 180 feet bgs. F11 concentrations ranged from 0.25 J to 0.57 J µg/L. F113 was detected in the samples from 130, 140, 160, and 180 feet bgs. F113 concentrations ranged from 0.56 J to 1.8 J µg/L. 1,4-dioxane was reported in all discrete-depth groundwater samples except from 230, 240, and 250 feet bgs. 1,4-dioxane concentrations ranged from 0.63 to 2.4 µg/L.

Other VOCs detected in the depth-specific samples include several chlorinated solvents, aromatic hydrocarbons, trihalomethanes (THMs), and solvents that are common laboratory contaminants (acetone, methyl ethyl ketone [MEK], and methylene chloride). The laboratory reports in Appendix I contain the results for all data (Table 3-2 presents the detected data).

### 3.3.2 Post-Development Groundwater Well Sample

VOCs were detected from the post-development groundwater sample collected from the completed well MW32 at concentrations higher than the depth-specific groundwater samples from the same depth interval (Table 3-2). The concentrations of TCE, PCE, F113, and 1,4-dioxane that are used to track VOCs from the Omega Site were up to approximately two times higher for the post-development samples (primary and duplicate) than the highest concentrations from the depth-specific samples. The lower concentrations of VOCs and 1,4-dioxane in the hydropunch sample compared with the well sample could be attributed to groundwater disturbance by drilling equipment causing groundwater mixing and volatilization of contaminants (although the Hydropunch was advanced ahead of the drill bit to avoid these effects); however, the Hydropunch screening sample results still follow a general trend of decreasing contaminant concentration with depth as has been established in previous investigations of OU2 (CH2M HILL 2010, 2011, 2012b).

PCE was detected in the primary and field duplicate samples at 20 and 21 µg/L, respectively. TCE was detected in the primary and field duplicate samples at 18 and 19 µg/L, respectively. F11 and F113 were detected in the primary and field duplicate samples at 2.2 J and 2.4 µg/L and 4.4 J and 5.5 µg/L, respectively. 1,4-dioxane was also reported in the post-development sample primary and duplicate samples; however, these detects were rejected based on Tier 3 data validation criteria. Refer to Section 3.3.4 for more details.

Other VOCs detected in the post-development samples include several chlorinated solvents, aromatic hydrocarbons, and THMs, similar to the depth-specific samples. Common laboratory contaminants (acetone, MEK, and methylene chloride) were not detected in the post-development samples. The laboratory reports in Appendix I contain the results for all data (Table 3-2 presents the detected data).

### 3.3.3 Soil Samples

The TOC soil samples results are reported in Table 3-3. Concentrations from soil samples range from < 200 U to 3,040 milligrams per kilogram (mg/kg) (corresponding to mass

fractions ranging from < 0.0002 to 0.003). Out of the 10 primary samples and one duplicate, TOC was detected above 200 mg/kg in only four samples.

The TOC fractions in the coarse-grained sediments are expected to be generally lower than the TOC fractions in the fine-grained sediments; at MW32 however, select sample depths did exhibit the opposite trend; coarse-grained samples at 161 and 213 feet bgs contain high concentrations of TOC, while samples at 182 and 216 feet bgs contain low concentration of TOC. In addition, the primary and duplicate samples at 161 feet bgs differ in TOC concentrations (<200 U and 2,550 mg/kg, respectively). The difference between the primary and duplicate is likely due to variation within the samples. The soil from the primary and duplicate were not aggregated and mixed together to mitigate any potential lithologic variation. The higher TOC in the sample at 213 feet bgs and lower nondetect TOC results for samples 182 and 216 feet bgs might also be related to lithologic variation within the sample. The method blanks, laboratory control samples, and MS/MSDs for TOC are within acceptable ranges. Overall, the TOC distribution at MW32 shows no correlation between TOC content and lithologic type. Out of three samples of clay, TOC was detected in one; out of four coarse sand samples, TOC was detected in two; out of four silt to fine sand samples, TOC was detected in one.

### 3.3.4 Data Review and Validation

The chemical data quality for MW32 data was managed through the following tools and processes:

- DQOs process as documented in project QA plan (CH2M HILL, 2004d) and 2012 SAP7 addendum (CH2M HILL, 2012a)
- Project QA plans define procedures and functional policies for data of known and appropriate quality along with FSPs (CH2M HILL, 2004d; CH2M HILL, 2004c) and 2006 addenda (CH2M HILL, 2006b; CH2M HILL, 2006a)
- Data validation and QA

Following is a description of the analytical methodology, data validation methodology, and findings. The validation reports and tables summarizing the QA are included in Appendix J.

The analytical parameters with the associated methods and the EPA analytical method references are contained in the project-specific QAPP (CH2M HILL, 2004d).

Analyses were carried out through the EPA Contract Laboratory Program (CLP), the analyses were per CLP methodology modified for lower detection where needed and QC procedures. SAP7 addendum shows the analytes and measurement performance criteria for MW32 (CH2M HILL, 2012a).

The post-development sample data from MW32 were validated manually by the EPA Regional QAO (Tier 3 validation per regional guidance).

Sample and parameter-specific data validation reports are in Appendix J where data validation findings and qualifications/flags are summarized.

The majority of data were found to be within data validation criteria. The only rejected data were for 1,4-dioxane results per independent Tier 3 validation, due to very low instrument

sensitivity (refer to Appendix J). The causes for the rejected data are noted to be isolated occurrences and not a systematic bias. These rejected data have not impacted project decisions as can be seen in this report. Data reported in this report include validation flags.

# 4. Summary and Conclusions

One deep groundwater monitoring well (MW32) was installed and sampled north/ northeast (upgradient) of the Pioneer production wells along Pioneer Boulevard in Norwalk, California to (1) confirm the continuity of VOC contamination between the currently identified OU2 groundwater plume and the Pioneer production wells, (2) assess the depth extent of VOC contamination upgradient of the Pioneer production wells, and (3) provide a permanent well location for ongoing groundwater monitoring between the currently identified OU2 groundwater plume and the Pioneer production wells.

The work associated with the installation and sampling of MW32 included drilling and continuous coring to a depth of 250 feet bgs, collecting discrete-depth groundwater samples at 10-foot intervals during drilling, the construction of MW32 with a screened interval from 163 to 178 feet bgs, geophysical logging in the constructed well (natural gamma and conductivity), developing the well, performing a short-term pumping test, and collecting a post-development groundwater sample from the MW32 well screen. Soil cores were analyzed for TOC, and the discrete-depth and post-development groundwater samples were analyzed for VOCs and 1,4-dioxane. In addition, all liquid and solid IDW were properly contained, transported, and disposed of as directed by SAP 7 addendum (CH2M HILL, 2012a).

These data are summarized as follows:

- The sands, silts, and occasional gravel encountered at MW32 are generally consistent with adjacent wells and previous interpretation from the 2010 RI/FS report (CH2M HILL, 2010).
- The installed piezometer MW32P is screened across the water table from 80 to 100 feet bgs, within the first saturated sand unit encountered that is correlated above SB3, which is part of the OU2 hydrostratigraphic interpretations within the RI/FS.
- The screened interval of MW32 from 163 to 178 feet bgs is within poorly graded sands and gravels that extend between 150 and 180 feet bgs and are underlain by a 9-foot-thick clayey unit. The sand-clay interface at 180 feet bgs may correlate with the SB3 boundary in the OU2 hydrostratigraphic interpretations from the RI/FS.
- The hydrostratigraphic observations from the MW32 data collected can be incorporated in the OU2 conceptual model to determine hydrostratigraphic correlation with the Pioneer wells.
- The calculated aquifer properties ($K_r$ = 136 to 192 feet per day and $S_s = 6.7 \times 10^{-5}$ per foot) are consistent with sandy material screened by MW32. The $K_r$ value is considered to be reliable and may be used to update the overall OU2 site conceptual model. The reliability of the $S_s$ value is considered to be low because no observation wells were used during the short-term pumping test.
- Groundwater levels are consistent with adjacent well data, interpolated contours, and flow directions by previous interpretation including the 2008 to 2011 groundwater

monitoring reports (CH2M HILL, 2011 and 2012b). There is a downward gradient from the piezometer screened across the water table (MW32P) to the main well screen (MW32) below the water table.

- TOC results from soil core samples indicate that TOC content is low and it is not dependent on the lithology. The expected general trend of high TOC in fine-grained soils and low TOC in coarse-grained soils was not confirmed. TOC data from this investigation can be incorporated into the site conceptual model in assessing VOC migration within OU2.
- Analytical results (VOCs and 1,4-dioxane) from discrete-depth sampling display a general trend of decreased concentrations with depth consistent with the RI/FS report. The results from this sampling are considered "screening level".
- Analytical results for the MW32 groundwater samples are consistent with the VOCs (TCE, PCE, F113) and 1,4-dioxane that are present in groundwater at OU2. The VOCs detected in MW32 are consistent with those detected in the Pioneer production wells.

MW32 will be included in the OU2 groundwater monitoring program. Future sampling in MW32 with dedicated low flow sampling equipment will provide additional sample results that can be correlated with adjacent wells and assist in the continued development of the site conceptual model. In addition, the future sampling will assist in tracking the contaminants of concern over time. Monitoring water levels at MW32 could be used to assess the hydraulic continuity of the sandy unit screened by MW32 and the units screened by the Pioneer wells.

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# Tables

**TABLE 3-1**

Groundwater Elevations from MW32

*Omega Chemical Corporation Superfund Site*

| Location | TOC ft msl | Gauging Date | DTW ft bgs | Groundwater Elevation ft msl |
|---|---|---|---|---|
| MW32 | 116.78 | 5/8/2012 | 86.88 | 29.90 |
| MW32P | 116.75 | 5/8/2012 | 83.36 | 33.39 |

Notes:

TOC = top of casing

DTW = depth to water

ft = feet mean sea level

Vertical Datum NAVD 88

**TABLE 3-2**

Detected VOCs and 1,4-dioxane in Groundwater, MW-32 Depth-Specific and Post-Development Groundwater Samples

*Omega Chemical Corporation Superfund Site*

| | | | | | | Chlorinated Solvents | | | | | | | Freons | | Aromatic Hydrocarbons | | | | | | THMs | | Solvents | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | Sample Date | Sample Type | Depth (feet, bgs) | CLP ID | 1,4-Dioxane (p-dioxane) | Tetrachloroethene (PCE) | Trichloroethene (TCE) | 1,1-Dichloroethane | 1,1-Dichloroethene | 1,2-Dichloroethane | 1,2-Dichloropropane | cis-1,2-Dichloroethene | 1,1,2-Trichloro-1,2,2-Trifluoro-ethane (Freon 113) | Trichloro-fluoro-methane (Freon 11) | 2-Hexanone | Benzene | Ethyl benzene µg/L | m,p-Xylenes | o-Xylene | Toluene | Bromo-form | Chloro-form | Acetone | Methyl ethyl ketone (MEK) | Methylene chloride |
| Depth-Specific Samples - above screened interval | | | | | | | | | | | | | | | | | | | | | | | | | |
| MW-32-110 | 4/24/12 | N | 110 | Y8C05 | **1.3** | **9.5** | **9.5** | **0.42 J** | **2 J** | 0.5 UJ | 0.5 U | **0.6 J** | 0.5 UJ | 0.5 UJ | 5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.31 J** | **1.7 J** | 5 U | **0.2 J** |
| MW-32-1120 | 4/24/12 | FD | 120 | Y8C16 | **1.2** | **1.2** | **2.1** | **0.18 J** | **0.55** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **4.6 J** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.13 J** | 0.5 U | **0.43 J** | **19** | **4.6 J** | **0.17 J** |
| MW-32-120 | 4/24/12 | N | 120 | Y8C07 | **1** | **1.3** | **2.4** | **0.18 J** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.14 J** | 0.5 U | **0.44 J** | **17** | 5 U | **0.17 J** |
| MW-32-130 | 4/25/12 | N | 130 | Y8C08 | **2.4** | **28** | **16** | **0.25 J** | **1.9** | 0.5 UJ | 0.5 U | **0.72** | **0.56 J** | 0.5 UJ | 5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.23 J** | 5 U | 5 U | 0.5 UJ |
| MW-32-140 | 4/25/12 | N | 140 | Y8C09 | **1.8** | **17** | **18** | **0.55** | **2.5** | **0.42 J** | 0.5 U | **1.5** | **1 J** | **0.25 J** | **5.9** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.3 J** | 5 U | 5 U | **0.47 J** |
| MW-32-150 | 4/26/12 | N | 150 | Y8C10 | **0.83** | **4.9** | **4.9** | 0.5 U | **0.6** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.27 J** | **16** | 5 U | **0.36 J** |
| Depth-Specific Samples - within screened interval | | | | | | | | | | | | | | | | | | | | | | | | | |
| MW-32-160 | 4/26/12 | N | 160 | Y8C11 | **1.9** | **15** | **12** | **0.69** | **2.6 J** | 0.5 UJ | 0.5 U | **0.97 J** | **1.8 J** | **0.55 J** | 5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.34 J** | 5 U | 5 U | 0.5 UJ |
| MW-32-170 | 4/26/12 | N | 170 | Y8C12 | **0.72** | **2.7** | **2.8** | 0.5 U | **0.42 J** | 0.5 UJ | 0.5 U | **0.24 J** | 0.5 UJ | 0.5 UJ | **3.4 J** | **0.2 J** | 0.5 U | 0.5 U | 0.5 U | **0.14 J** | 0.5 U | **1.4** | **15** | 5 U | **0.37 J** |
| MW-32-180 | 4/26/12 | N | 180 | Y8C13 | **0.72** | **9.2** | **9.1** | **0.55** | **2.5 J** | 0.5 U | 0.5 U | **0.8 J** | **1.6 J** | **0.57 J** | **3.4 J** | **0.31 J** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.47 J** | **13** | 5 U | **0.34 J** |
| MW-32-190 | 4/26/12 | N | 190 | Y8C14 | **0.63** | **1.8** | **3.8** | 0.5 U | **0.3 J** | 0.5 UJ | 0.5 U | 0.5 U | 0.5 UJ | 0.5 UJ | 5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **11** | 5 U | 0.5 UJ |
| Depth-Specific Samples - below screened interval | | | | | | | | | | | | | | | | | | | | | | | | | |
| MW-32-200 | 4/27/12 | N | 200 | Y8C15 | **0.77** | **2.6** | **6** | 0.5 U | 0.5 U | 0.5 UJ | 0.5 U | 0.5 U | 0.5 UJ | 0.5 UJ | **4 J** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 UJ | 0.5 U | **5.3** | **1.9 J** | 0.5 UJ |
| MW-32-210 | 4/27/12 | N | 210 | Y8C18 | **1.1** | **1.9** | **2.7** | 0.5 U | 0.5 U | 0.5 UJ | 0.5 U | 0.5 U | 0.5 UJ | 0.5 UJ | **5.7** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **5.6 J** | **0.83** | **13** | 5 U | 0.5 UJ |
| MW-32-220 | 4/27/12 | N | 220 | Y8C19 | **0.87** | **0.82** | **3.1** | 0.5 U | 0.5 U | 0.5 UJ | 0.5 U | **0.4 J** | 0.5 UJ | 0.5 UJ | **3.7 J** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 UJ | 0.5 U | **9.1** | 5 U | 0.5 UJ |
| MW-32-230 | 4/30/12 | N | 230 | Y8C20 | 0.5 U | 0.5 U | **0.49 J** | 0.5 U | 0.5 U | 0.5 UJ | 0.5 U | 0.5 U | 0.5 UJ | 0.5 UJ | **4.1 J** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.13 J** | 0.5 U | 0.5 U | **8.6** | 5 U | 0.5 UJ |
| MW-32-240 | 4/30/12 | N | 240 | Y8C21 | 0.5 U | **0.38 J** | **2.2** | 0.5 U | 0.5 U | 0.5 UJ | 0.5 U | **0.36 J** | 0.5 UJ | 0.5 UJ | **5.2** | **0.31 J** | 0.5 U | 0.5 U | 0.5 U | **0.18 J** | 0.5 U | **0.8** | **11** | 5 U | 0.5 UJ |
| MW-32-250 | 4/30/12 | N | 250 | Y8C22 | 0.5 U | **0.39 J** | **1.7** | 0.5 U | 0.5 U | 0.5 UJ | 0.5 U | **0.28 J** | 0.5 UJ | 0.5 UJ | **3.4 J** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.18 J** | 0.5 U | **0.74** | **8.7** | 5 U | 0.5 UJ |
| Post-Development Groundwater Well Samples | | | | | | | | | | | | | | | | | | | | | | | | | |
| 170 | 5/8/12 | N | 170 | Y8C26 | **3.9 R** | **20** | **18** | **1.8** | **7.2 J** | **0.8 J** | 0.5 U | **2.3 J** | **4.4 J** | **2.2 J** | 5 U | **0.9** | **0.24 J** | **0.69** | **0.58** | **15** | 0.5 U | **0.71** | 5 U | 5 U | 0.5 UJ |
| 170 Dup | 5/8/12 | FD | 170 | Y8C27 | **2.2 R** | **21** | **19** | **1.8** | **7 J** | **0.83** | 0.5 U | **2.2 J** | **5.5** | **2.4** | 5 U | **0.87** | **0.21 J** | **0.61** | **0.53** | **15** | 0.5 U | **0.7** | 5 U | 5 U | 0.5 U |

Notes:

Units in µg/L

N = Normal

FD = Field duplicate

U = Not detected at the laboratory reporting limit

J = Concentration or reporting limit estimated by laboratory or data validation

R = Rejected by data validation

**TABLE 3-3**

Total Organic Carbon in MW32 Soil Samples

*Omega Chemical Corporation Superfund Site*

| Sample ID | Depth Location | Sample Date | Matrix | Sample Type (Units) | Total Organic Carbon (mg/Kg) | Corresponding Lithology |
|---|---|---|---|---|---|---|
| MW-32-100 | 100 | 4/24/2012 | Soil | N | **3,040** | silt with sand |
| MW-32-115 | 115 | 4/30/2012 | Soil | N | 200 U | fine to medium sand |
| MW-32-128 | 128 | 4/30/2012 | Soil | N | 200 U | medium to coarse sand |
| MW-32-143 | 143 | 4/30/2012 | Soil | N | **1,210** | clay |
| MW-32-161 | 161 | 4/30/2012 | Soil | N | 200 U | coarse sand with gravel |
| MW-32-1161 | 161 | 4/30/2012 | Soil | FD | **2,550** | coarse sand with gravel |
| MW-32-182 | 182 | 4/30/2012 | Soil | N | 200 U | clay |
| MW-32-204 | 204 | 4/30/2012 | Soil | N | 200 U | fine sand |
| MW-32-213 | 213 | 4/30/2012 | Soil | N | **970** | medium to coarse sand |
| MW-32-216 | 216 | 4/30/2012 | Soil | N | 200 U | clay |
| MW-32-229 | 229 | 4/30/2012 | Soil | N | 200 U | fine to medium sand |

Notes:

Detected values are bolded

mg/kg = milligrams per kilogram

# Figures

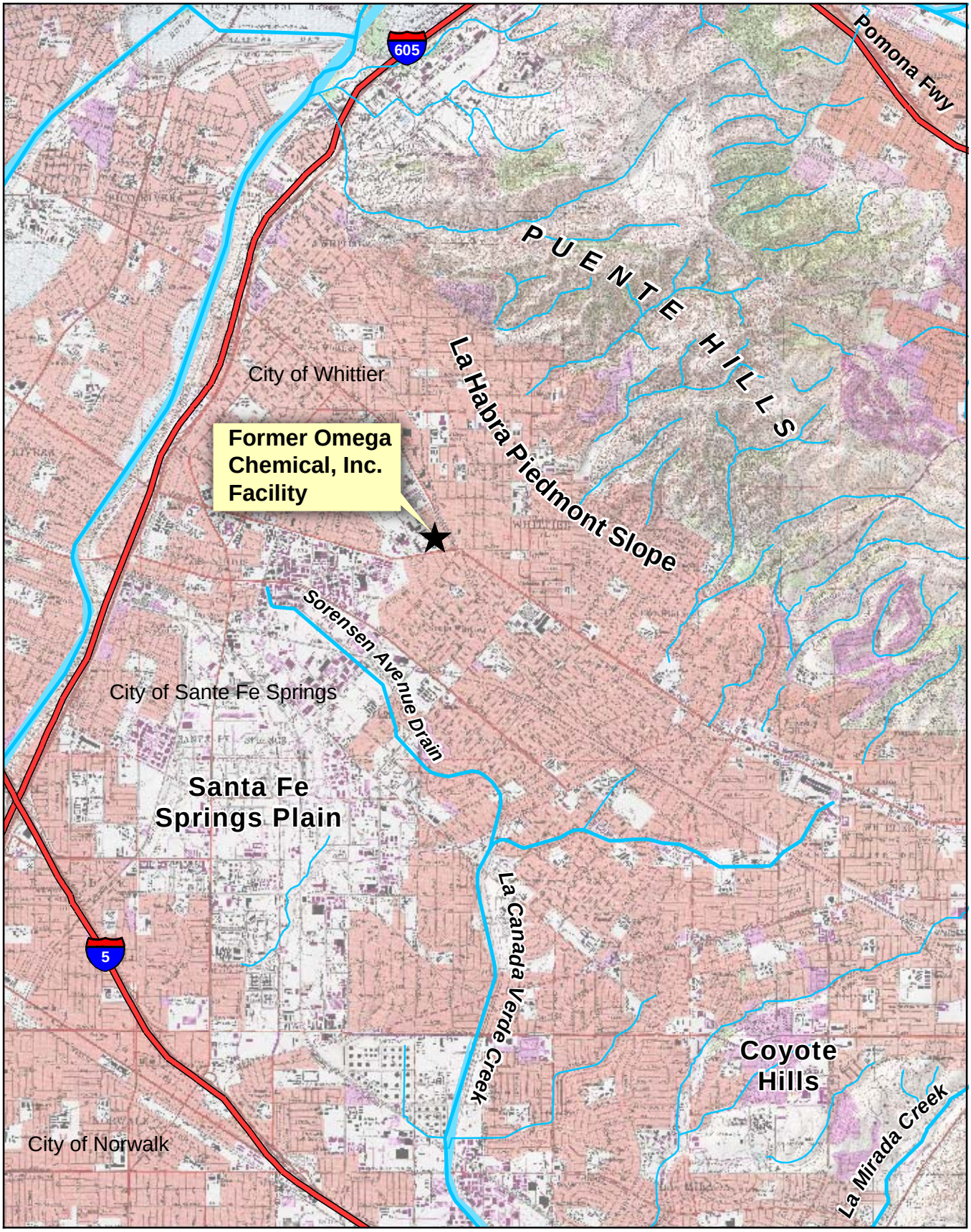
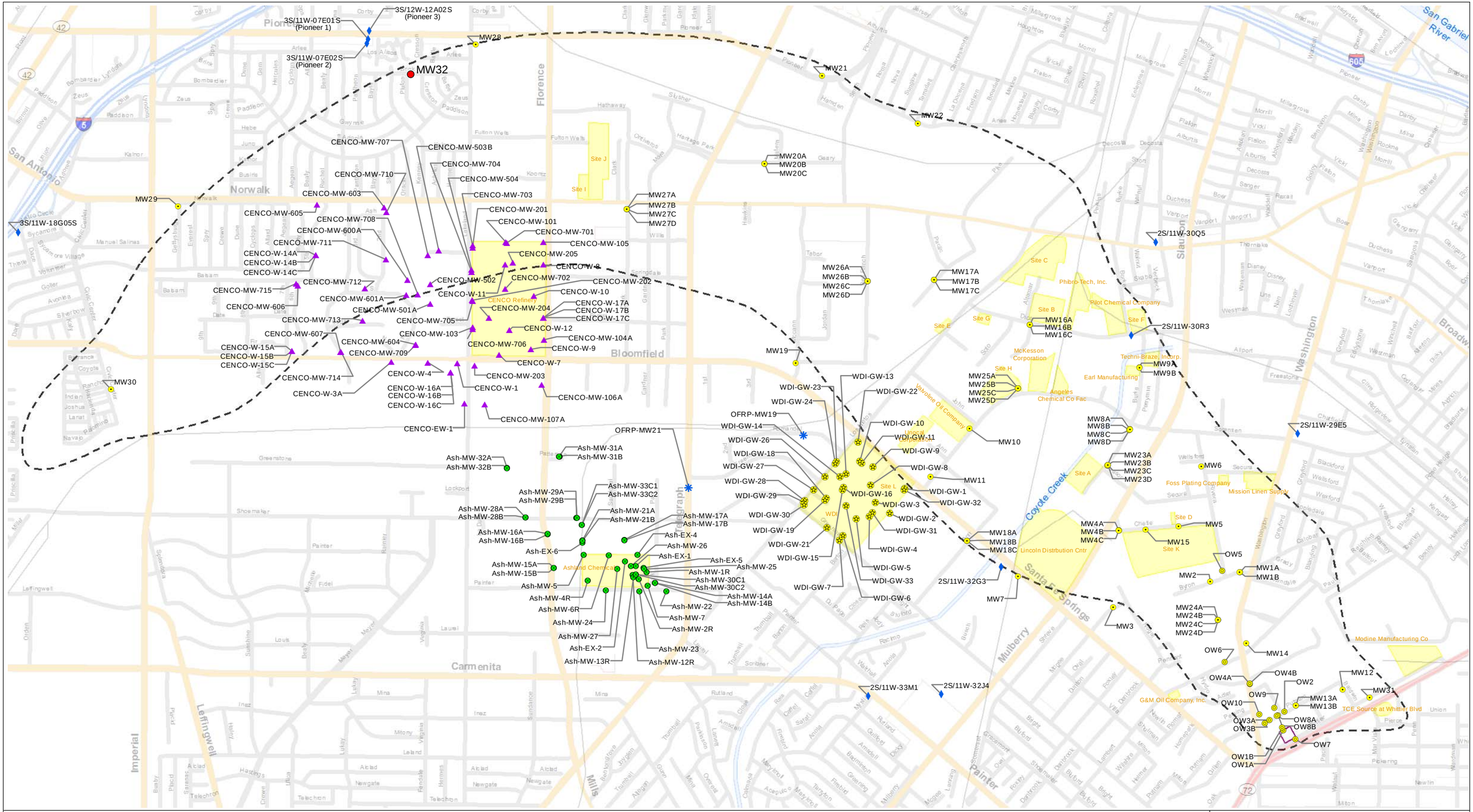



**Figure 1-1**
**Facility Location Map**
**Omega Chemical Superfund Site**

CH2MHILL

ES062006002SCO335392.RR.01 EPA_Omega_SiteLoc.ai 05/08




**Legend**

- EPA Monitoring Well
- Omega Potentially Responsible Parties Organized Group (OPOG) Monitoring Well
- Ashland Chemical Well
- CENCO Well
- Oil Field Reclamation Project (OFRP) Well
- Waste Disposal, Inc. Well
- Production Well
- MW32 Surveyed Location
- OU2 Boundary
- Approximate Boundary of Facilities
- Former Omega Facility

N

0 750 1,500

Feet

**Figure 1-2**
**Monitoring Well Locations**

Omega Chemical Superfund Site

CH2MHILL

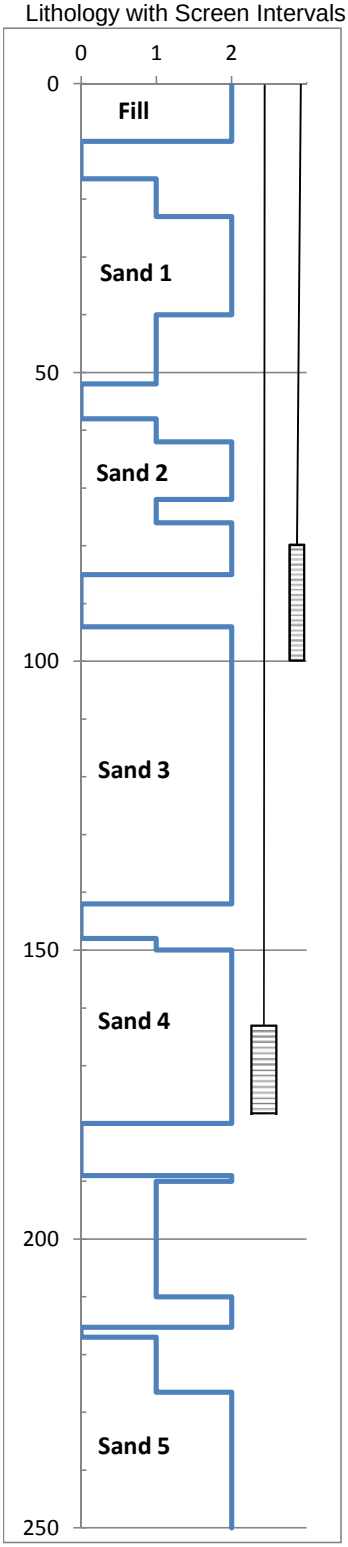
Path: \\cheron\proj\EPA\386743OmegaOU2\GIS\2010-2011 Annual Report\Omega_2010-2011_Report\ArcMap Documents\Monitoring Well Locations\Figure_1-2_Monitoring_Well_Locations_final_MW32.mxd

Figure 3-1

Summary of Lithology and Select VOCs in Depth-Specific Groundwater Samples at MW-32

*Omega Chemical Superfund Site*

Lithology with Screen Intervals




VOCs and 1,4-Dioxane in Groundwater

| Depth (feet) | Concentration (µg/L) | | | |
|---|---|---|---|---|
| | TCE | PCE | F113 | 1,4-dioxane |
| 10 | --- | --- | --- | --- |
| 20 | --- | --- | --- | --- |
| 30 | --- | --- | --- | --- |
| 40 | --- | --- | --- | --- |
| 50 | --- | --- | --- | --- |
| 60 | --- | --- | --- | --- |
| 70 | --- | --- | --- | --- |
| 80 | --- | --- | --- | --- |
| | **Approximate Water Table** | | | |
| 90 | --- | --- | --- | --- |
| 100 | --- | --- | --- | --- |
| 110 | 9.5 | 9.5 | ND | 1.3 |
| 120 | 2.4 | 1.3 | ND | 1 |
| 130 | 16 | 28 | 0.56 | 2.4 |
| 140 | 18 | 17 | 1 | 1.8 |
| 150 | 4.9 | 4.9 | ND | 0.83 |
| 160 | 12 | 15 | 1.8 | 1.9 |
| 170 | 2.8 | 2.7 | ND | 0.72 |
| 180 | 9.1 | 9.2 | 1.6 | 0.72 |
| 190 | 3.8 | 1.8 | ND | 0.63 |
| 200 | 6 | 2.6 | ND | 0.77 |
| 210 | 2.7 | 1.9 | ND | 1.1 |
| 220 | 3.1 | 0.82 | ND | 0.87 |
| 230 | 0.49 | ND | ND | ND |
| 240 | 2.2 | 0.38 | ND | ND |
| 250 | 1.7 | 0.39 | ND | ND |

**Lithology:**

0 = Clay
1 = Silt
2 = Sand

**Notes:**

ND = Not detected
MW32P Screened from 80 to 100 feet bgs (across Sand 2)
MW32 Screened from 163 to 178 feet bgs (across Sand 4)

# Appendix A
# Encroachment and Well Construction Permits
# (on CD only)

# Appendix B
# Boring Log and Soil Core Photographs

CH2MHILL

| PROJECT NUMBER: | BORING NUMBER: | |
|---|---|---|
| 386743.FI.02 | MW-32 | SHEET 1 OF 11 |

# Soil Boring Log

PROJECT : Omega Chemical Corporation

LOCATION : Brink Avenue and Pluton Street

ELEVATION : 117.1 ft msl (ground surface) NAVD 88

DRILLING CONTRACTOR AND DRILL RIG : Cascade Drilling, L.P., Rotosonic

COORDINATES : N 1796526.14, E 6537526.08 NAD 83

DRILLING METHOD AND EQUIPMENT : 6"/7"/8"/9.625" Casings

WATER LEVEL : 86.9 ft bgs, 83.39 ft bgs

START : 4/23/2012

END : 5/5/2012

LOGGER : C. Kamali

| DEPTH BELOW GROUND SURFACE (ft) | CORE INTERVAL LOGGED (ft) | SAMPLE TYPE FOR ANALYSIS | ENVIRONMENTAL DATA (PID = ppm) | GRAPHIC LOG | SOIL DESCRIPTION<br>SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY | COMMENTS<br>DEPTH OF CASING, DRILLING DETAILS, INSTRUMENTATION | WELL GRAPHIC | ELECTRIC LOG (ohms)<br>Gamma Resistivity<br>25 50 75 100 |
|---|---|---|---|---|---|---|---|---|
| | 0.0 | | | | Hand augered to 10.0' bgs for subsurface utility clearance | | | |
| 5 | | | | | | | | |
| 10 | 10.0 | | PID = 0.0 | | **SILT (ML)**<br>brown (7.5YR 4/4), moist, 90% fines, 10% fine sand, low plasticity | | | |
| | | | | | **SILT WITH SAND (ML)**<br>light yellowish brown (2.5Y 6/3), moist, 75% fines, 25% fine sand, trace mica, low plasticity | | | |
| 15 | | | | | | | | |
| | | | | | **LEAN CLAY (CL)**<br>pale brown (10YR 6/3), moist, 100% fines, some brown spots, low plasticity | | | |
| | 18.0 | | | | | | | |
| 20 | | | PID = 0.2 | | | | | |
| | 18.0 | | | | **POORLY GRADED SAND (SP)**<br>light olive brown (2.5Y 5/3), moist, 80% fine sand, | | | |

SOIL BORING LOG OMEGA; DRAFT CH2M GEOTECH_12.GLB; 386743_060412.GPJ; CH2M GEOTECH_12.GDT; 7/13/12

CH2MHILL

| PROJECT NUMBER: | BORING NUMBER: | |
|---|---|---|
| 386743.FI.02 | MW-32 | SHEET 2 OF 11 |

# Soil Boring Log

PROJECT : Omega Chemical Corporation
LOCATION : Brink Avenue and Pluton Street

ELEVATION : 117.1 ft msl (ground surface) NAVD 88
DRILLING CONTRACTOR AND DRILL RIG : Cascade Drilling, L.P., Rotosonic

COORDINATES : N 1796526.14, E 6537526.08 NAD 83
DRILLING METHOD AND EQUIPMENT : 6"/7"/8"/9.625" Casings

WATER LEVEL : 86.9 ft bgs, 83.39 ft bgs
START : 4/23/2012
END : 5/5/2012
LOGGER : C. Kamali

| DEPTH BELOW GROUND SURFACE (ft) | CORE INTERVAL LOGGED (ft) | SAMPLE TYPE FOR ANALYSIS | ENVIRONMENTAL DATA (PID = ppm) | GRAPHIC LOG | SOIL DESCRIPTION<br>SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY | COMMENTS<br>DEPTH OF CASING, DRILLING DETAILS, INSTRUMENTATION | WELL GRAPHIC | ELECTRIC LOG (ohms)<br>Gamma — Resistivity<br>25 50 75 100 |
|---|---|---|---|---|---|---|---|---|
| | | | | | 15% medium sand, 5% fines | | | |
| 25 | | | | | **WELL GRADED SAND (SW)**<br>light yellowish brown (2.5Y 6/3), moist, 60% medium sand, 30% fine sand, 10% coarse sand, trace fine gravel of quartz, subangular | | | |
| | 28.0 | | | | **SILTY SAND (SM)**<br>light olive brown (2.5Y 5/3), moist, 70% fine sand, 30% non plastic fines, trace mica | | | |
| | | | | | **POORLY GRADED SAND (SP)**<br>light olive brown (2.5Y 5/4), moist, 60% fine sand, 40% medium sand, trace mica | | | |
| 30 | | | | | **WELL GRADED SAND (SW)**<br>light olive brown (2.5Y 5/4), moist, 45% medium sand, 40% fine sand, 5% fines at top, trace fine gravel of quartz | | | |
| | 34.0 | | | | light yellowish brown (2.5Y 6/3), moist, 60% medium sand, 20% coarse sand, 15% fine sand, 5% fine gravel | | | |
| 35 | | | | | **SILT (ML)**<br>brown (10YR 5/3), moist, 90% fines, 10% fine sand, low plasticity | | | |
| | | | | | **WELL GRADED SAND (SW)**<br>light yellowish brown (2.5Y 6/3), moist, 50% medium sand, 30% fine sand, 15% coarse sand, 5% fines as lenses, moderately cemented | | | |
| 40 | 40.0 | | | | **SANDY SILT (ML)**<br>moist, 70% fines, 30% fine sand, trace mica, some coarse gravel of siliceous material, vuggy, caliche? | | | |
| 45 | | | | | **SILTY SAND (SM)**<br>light olive brown (2.5Y 5/4), moist, 80% fine sand, 20% fines, micaceous | | | |
| | | | | | **LEAN CLAY (CL)**<br>light olive brown (2.5Y 5/3), 95% fines, 5% fine sand, trace mica, locally a few gravels of siliceous material up to 2", caliche? | | | |
| | 40.0 | | | | | | | |

SOIL BORING LOG OMEGA; DRAFT CH2M GEOTECH_12.GLB; 386743_060412.GPJ; CH2M GEOTECH_12.GDT; 7/13/12

| PROJECT NUMBER: | BORING NUMBER: | |
|---|---|---|
| 386743.FI.02 | MW-32 | SHEET 3 OF 11 |

CH2MHILL

# Soil Boring Log

PROJECT : Omega Chemical Corporation

LOCATION : Brink Avenue and Pluton Street

ELEVATION : 117.1 ft msl (ground surface) NAVD 88

DRILLING CONTRACTOR AND DRILL RIG : Cascade Drilling, L.P., Rotosonic

COORDINATES : N 1796526.14, E 6537526.08 NAD 83

DRILLING METHOD AND EQUIPMENT : 6"/7"/8"/9.625" Casings

WATER LEVEL : 86.9 ft bgs, 83.39 ft bgs

START : 4/23/2012

END : 5/5/2012

LOGGER : C. Kamali

| DEPTH BELOW GROUND SURFACE (ft) | CORE INTERVAL LOGGED (ft) | SAMPLE TYPE FOR ANALYSIS | ENVIRONMENTAL DATA (PID = ppm) | GRAPHIC LOG | SOIL DESCRIPTION<br>SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY | COMMENTS<br>DEPTH OF CASING, DRILLING DETAILS, INSTRUMENTATION | WELL GRAPHIC | ELECTRIC LOG (ohms)<br>Gamma Resistivity<br>25 50 75 100 |
|---|---|---|---|---|---|---|---|---|
| 50 | | | | | | | | |
| | | | PID = 0.2 | | **FAT CLAY (CH)**<br>olive (5Y 5/3), moist, 90% fines, 5% fine sand, 5% gravel of silicified material, up to 2", medium to high plasticity | | | |
| | 52.0 | | | | | | | |
| 55 | | | | | | | | |
| | | | | | **SILTY SAND (SM)**<br>light olive brown (2.5Y 5/4), moist, 80% fine sand, 20% fines, trace mica | | | |
| | 58.0 | | | | **SANDY SILT (ML)**<br>light olive brown (2.5Y 5/3), moist, 70% nonplastic fines, 30% fine sand, locally iron oxide and manganese oxide stainings at 58.0-59.0' bgs | | | |
| 60 | | | | | | | | |
| | 62.0 | | | | **POORLY GRADED SAND (SP)**<br>light olive brown (2.5Y 5/4), moist, 95% fine sand, 5% nonplastic fines | | | |
| | | | | | **SILTY SAND (SM)**<br>light olive brown (2.5Y 5/3), moist, 70% fine sand, 30% fines, trace fine mica, thin iron oxide stringers | | | |
| 65 | | | | | | | | |
| | | | | | **POORLY GRADED SAND (SP)**<br>light yellowish brown (2.5Y 6/4), moist, 65% medium sand, 30% fine sand, 5% fines, trace coarse sand, 2" thick silt at bottom | | | |
| 70 | 70.0 | | PID = 0.6 | | | | | |
| | | | | | **SILT WITH SAND (ML)**<br>light olive brown (2.5Y 5/3), moist, 75% fines, 25% fine sand as thin lenses, local iron oxide staining, trace mica | | | |
| | 72.0 | | | | | | | |

SOIL BORING LOG OMEGA; DRAFT CH2M GEOTECH_12.GLB; 386743_060412.GPJ; CH2M GEOTECH_12.GDT; 7/13/12

CH2MHILL

| PROJECT NUMBER: | BORING NUMBER: | |
|---|---|---|
| 386743.FI.02 | MW-32 | SHEET 4 OF 11 |

# Soil Boring Log

PROJECT : Omega Chemical Corporation

LOCATION : Brink Avenue and Pluton Street

ELEVATION : 117.1 ft msl (ground surface) NAVD 88

DRILLING CONTRACTOR AND DRILL RIG : Cascade Drilling, L.P., Rotosonic

COORDINATES : N 1796526.14, E 6537526.08 NAD 83

DRILLING METHOD AND EQUIPMENT : 6"/7"/8"/9.625" Casings

WATER LEVEL : 86.9 ft bgs, 83.39 ft bgs

START : 4/23/2012

END : 5/5/2012

LOGGER : C. Kamali

| DEPTH BELOW GROUND SURFACE (ft) | CORE INTERVAL LOGGED (ft) | SAMPLE TYPE FOR ANALYSIS | ENVIRONMENTAL DATA (PID = ppm) | GRAPHIC LOG | SOIL DESCRIPTION<br>SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY | COMMENTS<br>DEPTH OF CASING, DRILLING DETAILS, INSTRUMENTATION | WELL GRAPHIC | ELECTRIC LOG (ohms)<br>Gamma Resistivity<br>25 50 75 100 |
|---|---|---|---|---|---|---|---|---|
| 75 | | | | | **WELL GRADED SAND (SW)**<br>light olive brown (2.5Y 5/4), moist, 40% medium sand, 30% coarse sand, 20% fine sand, 10% fine to coarse gravel, up to 2", subrounded, quartz | | | |
| | 76.0 | | | | **SILT (ML)**<br>light gray (2.5Y 7/2), moist, 95% fines, 5% coarse sand, strongly cemented, siltstone | | | |
| | | | | | **SILT WITH SAND (ML)**<br>grayish brown (2.5Y 5/2), moist, 75% fines, 25% fine to medium sand, weakly cemented | | | |
| | | | | | **POORLY GRADED SAND (SP)**<br>light yellowish brown (2.5Y 6/3), moist, 60% fine sand, 40% medium sand, trace mica | | | |
| 80 | | | PID = 0.2 | | | | | |
| | 82.0 | | | | **WELL GRADED SAND (SW)**<br>light yellowish brown (2.5Y 6/3), moist, 40% medium sand, 30% coarse sand, 10% fine gravel of quartz and granitic composition, up to 7", subrounded | | | |
| 85 | | | | | **FAT CLAY (CH)**<br>brown (7.5YR 5/4), moist, 95% fines, 5% sand, high plasticity, layer of sand with gravel at 88.0-89.5' bgs and 90.0-91.0 ft bgs | | | |
| 90 | 90.0 | | PID = 0.2 | | | | | |
| 95 | | | | | **POORLY GRADED SAND (SP)**<br>light olive brown (2.5Y 5/4), wet, 70% medium sand, 30% fine sand, micaceous | | | |
| | 90.0 | | | | | | | |

CH2MHILL

| PROJECT NUMBER: | BORING NUMBER: | |
|---|---|---|
| 386743.FI.02 | MW-32 | SHEET 5 OF 11 |

# Soil Boring Log

PROJECT : Omega Chemical Corporation

LOCATION : Brink Avenue and Pluton Street

ELEVATION : 117.1 ft msl (ground surface) NAVD 88

DRILLING CONTRACTOR AND DRILL RIG : Cascade Drilling, L.P., Rotosonic

COORDINATES : N 1796526.14, E 6537526.08 NAD 83

DRILLING METHOD AND EQUIPMENT : 6"/7"/8"/9.625" Casings

WATER LEVEL : 86.9 ft bgs, 83.39 ft bgs

START : 4/23/2012

END : 5/5/2012

LOGGER : C. Kamali

| DEPTH BELOW GROUND SURFACE (ft) | CORE INTERVAL LOGGED (ft) | SAMPLE TYPE FOR ANALYSIS | ENVIRONMENTAL DATA (PID = ppm) | GRAPHIC LOG | SOIL DESCRIPTION<br>SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY | COMMENTS<br>DEPTH OF CASING, DRILLING DETAILS, INSTRUMENTATION |
|---|---|---|---|---|---|---|
| 100 | | SOIL | PID = 0.2 | | **FAT CLAY (CH)**<br>light olive brown (2.5Y 5/4), moist, 100% fines, high plasticity | |
| | 102.0 | | | | **SILT WITH SAND (ML)**<br>light olive brown (2.5Y 5/4), moist, 75% nonplastic fines, 25% fine sand, trace fine mica | switch to 8" casing at 100.0' bgs<br>MW-32-100, soil sample for TOC |
| 105 | | | | | **WELL GRADED SAND (SW)**<br>light olive brown (2.5Y 5/4), wet, 50% medium sand, 20% fine sand, 20% coarse sand, 10% gravel of granitic composition, subrounded, up to 2", micaceous | |
| | | | | | **POORLY GRADED SAND (SP)**<br>light olive brown (2.5Y 5/4), wet, 70% medium sand, 30% fine sand, trace mica | |
| 110 | 110.0 | HP | PID = 0.0 | | | Y8C05, hydropunch groundwater sample |
| 115 | | SOIL | | | light brownish gray (2.5Y 6/2), 70% medium sand, 30% coarse sand, trace gravel of granitic composition, up to 3", subrounded, trace mica | MW-32-115, MW-32-1161, soil sample for TOC with Duplicate |
| 120 | 120.0 | | | | | |

WELL GRAPHIC

ELECTRIC LOG (ohms)

Gamma Resistivity

25 50 75 100

SOIL BORING LOG OMEGA; DRAFT CH2M GEOTECH_12.GLB; 386743_060412.GPJ; CH2M GEOTECH_12.GDT; 7/13/12

CH2MHILL

| PROJECT NUMBER: | BORING NUMBER: | |
|---|---|---|
| 386743.FI.02 | MW-32 | SHEET 6 OF 11 |

# Soil Boring Log

PROJECT : Omega Chemical Corporation
LOCATION : Brink Avenue and Pluton Street

ELEVATION : 117.1 ft msl (ground surface) NAVD 88
DRILLING CONTRACTOR AND DRILL RIG : Cascade Drilling, L.P., Rotosonic

COORDINATES : N 1796526.14, E 6537526.08 NAD 83
DRILLING METHOD AND EQUIPMENT : 6"/7"/8"/9.625" Casings

WATER LEVEL : 86.9 ft bgs, 83.39 ft bgs
START : 4/23/2012
END : 5/5/2012
LOGGER : C. Kamali

| DEPTH BELOW GROUND SURFACE (ft) | CORE INTERVAL LOGGED (ft) | SAMPLE TYPE FOR ANALYSIS | ENVIRONMENTAL DATA (PID = ppm) | GRAPHIC LOG | SOIL DESCRIPTION<br>SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY | COMMENTS<br>DEPTH OF CASING, DRILLING DETAILS, INSTRUMENTATION |
|---|---|---|---|---|---|---|
| | | HP | | | **POORLY GRADED SAND (SP)**<br>light brownish gray (2.5Y 6/2), wet, 60% medium sand, 40% coarse sand, trace fine gravel of granitic composition | Y8C07, hydropunch groundwater sample, with Y8C16 duplicate |
| 125 | | | | | | |
| | | SOIL | | | | MW-32-128, soil sample for TOC |
| 130 | 130.0 | HP | PID = 0.4 | | **SILTY SAND (SM)**<br>light olive brown (2.5Y 5/4), wet, 75% fine sand, 25% nonplastic fines, trace fine mica | Y8C08, hydropunch groundwater sample |
| 135 | | | | | | |
| 140 | 140.0 | HP | PID = 0.7 | | **SILTY SAND (SM)**<br>olive brown (2.5Y 4/4), 60% fine sand, 40% nonplastic fines, trace fine mica | stopped at 140.0' bgs on 4/25/12<br>Y8C09, hydropunch groundwater sample |
| | | | | | **FAT CLAY (CH)**<br>light olive brown (2.5Y 5/4), wet, 100% fines, some brown organic stringers, high plasticity | |
| | 140.0 | SOIL | | | | MW-32-143, soil sample for TOC |

WELL GRAPHIC

ELECTRIC LOG (ohms)
Gamma Resistivity
25 50 75 100

SOIL BORING LOG OMEGA; DRAFT CH2M GEOTECH_12.GLB; 386743_060412.GPJ; CH2M GEOTECH_12.GDT; 7/13/12

| PROJECT NUMBER: | BORING NUMBER: | |
|---|---|---|
| 386743.FI.02 | MW-32 | SHEET 7 OF 11 |

CH2MHILL®

# Soil Boring Log

PROJECT : Omega Chemical Corporation
LOCATION : Brink Avenue and Pluton Street

ELEVATION : 117.1 ft msl (ground surface) NAVD 88
DRILLING CONTRACTOR AND DRILL RIG : Cascade Drilling, L.P., Rotosonic

COORDINATES : N 1796526.14, E 6537526.08 NAD 83
DRILLING METHOD AND EQUIPMENT : 6"/7"/8"/9.625" Casings

WATER LEVEL : 86.9 ft bgs, 83.39 ft bgs
START : 4/23/2012
END : 5/5/2012
LOGGER : C. Kamali

| DEPTH BELOW GROUND SURFACE (ft) | CORE INTERVAL LOGGED (ft) | SAMPLE TYPE FOR ANALYSIS | ENVIRONMENTAL DATA (PID = ppm) | GRAPHIC LOG | SOIL DESCRIPTION<br>SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY | COMMENTS<br>DEPTH OF CASING, DRILLING DETAILS, INSTRUMENTATION | WELL GRAPHIC | ELECTRIC LOG (ohms)<br>Gamma / Resistivity<br>25 50 75 100 |
|---|---|---|---|---|---|---|---|---|
| 145 | | | | | | | | |
| | | | | | **SILT (ML)**<br>light olive brown (2.5Y 5/4), wet, 95% fines, 5% gravel of siliceous rock with rough surface, up to 3", subrounded, low plasticity | | | |
| 150 | 150.0 | HP | PID = 0.3 | | **SILTY SAND (SM)**<br>olive brown (2.5Y 4/4), wet, 70% fine sand, 30% fines as thin lenses throughout, trace mica, iron oxide staining locally | Y8C10, hydropunch groundwater sample | | |
| 155 | | | | | | | | |
| 160 | 160.0 | HP<br>SOIL | PID = 0.0 | | **POORLY GRADED SAND WITH GRAVEL (SP)**<br>light yellowish brown (2.5Y 6/3), wet, 70% coarse sand, 15% medium sand, 15% fine to coarse gravel of quartz and granitic composition, subrounded, trace mica | Y8C11, hydropunch groundwater sample<br>MW-32-161, soil sample for TOC | | |
| 165 | | | | | | | | |
| | 160.0 | | | | | | | |

SOIL BORING LOG OMEGA; DRAFT CH2M GEOTECH_12.GLB; 386743_060412.GPJ; CH2M GEOTECH_12.GDT; 7/13/12

| PROJECT NUMBER: | BORING NUMBER: | |
|---|---|---|
| 386743.FI.02 | MW-32 | SHEET 8 OF 11 |

CH2MHILL®

# Soil Boring Log

PROJECT : Omega Chemical Corporation
LOCATION : Brink Avenue and Pluton Street

ELEVATION : 117.1 ft msl (ground surface) NAVD 88
DRILLING CONTRACTOR AND DRILL RIG : Cascade Drilling, L.P., Rotosonic

COORDINATES : N 1796526.14, E 6537526.08 NAD 83
DRILLING METHOD AND EQUIPMENT : 6"/7"/8"/9.625" Casings

WATER LEVEL : 86.9 ft bgs, 83.39 ft bgs
START : 4/23/2012
END : 5/5/2012
LOGGER : C. Kamali

| DEPTH BELOW GROUND SURFACE (ft) | CORE INTERVAL LOGGED (ft) | SAMPLE TYPE FOR ANALYSIS | ENVIRONMENTAL DATA (PID = ppm) | GRAPHIC LOG | SOIL DESCRIPTION<br>SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY | COMMENTS<br>DEPTH OF CASING, DRILLING DETAILS, INSTRUMENTATION |
|---|---|---|---|---|---|---|
| 170 | 170.0 | HP | PID = 0.0 | | | Y8C12, hydropunch groundwater sample |
| 175 | | | | | **WELL GRADED GRAVEL WITH SAND (GW)**<br>light olive brown (2.5Y 5/4), wet, 60% fine to coarse gravel, 40% medium to coarse sand, up to 2", subrounded, quartz and granitic composition | |
| | | | | | **POORLY GRADED SAND (SP)**<br>light olive brown (2.5Y 5/3), wet, 60% medium sand, 35% fine sand, 5% gravel of quartz, subrounded, trace mica | |
| 180 | 180.0 | HP | PID = 0.0 | | **FAT CLAY (CH)**<br>yellowish brown / moderate yellowish brown (10YR 5/4), moist, 100% fines, high plasticity, trace fine mica, locally trace gravel of hard claystone | Y8C13, hydropunch groundwater sample |
| | | SOIL | | | | MW-32-182, soil sample for TOC |
| 185 | | | | | | |
| 190 | 190.0 | HP | PID = 0.1 | | **SILTY SAND (SM)**<br>yellowish brown / moderate yellowish brown (10YR 5/4), wet, 60% fine sand, 40% fines, trace mica | |
| | 190.0 | | | | **SANDY SILT (ML)**<br>light olive brown (2.5Y 5/4), wet, 70% fines, 30% fine sand, trace fine mica, low plasticity, trace gravel of siliceous rock up to 2" at 191.5' bgs | switch to 7" casing at 190.0' bgs<br>Y8C14, hydropunch groundwater sample |

WELL GRAPHIC

ELECTRIC LOG (ohms)
Gamma Resistivity
25 50 75 100

SOIL BORING LOG OMEGA; DRAFT CH2M GEOTECH_12.GLB; 386743_060412.GPJ; CH2M GEOTECH_12.GDT; 7/13/12

CH2MHILL

| PROJECT NUMBER: | BORING NUMBER: | |
|---|---|---|
| 386743.FI.02 | MW-32 | SHEET 9 OF 11 |

# Soil Boring Log

PROJECT : Omega Chemical Corporation
LOCATION : Brink Avenue and Pluton Street

ELEVATION : 117.1 ft msl (ground surface) NAVD 88
DRILLING CONTRACTOR AND DRILL RIG : Cascade Drilling, L.P., Rotosonic

COORDINATES : N 1796526.14, E 6537526.08 NAD 83
DRILLING METHOD AND EQUIPMENT : 6"/7"/8"/9.625" Casings

WATER LEVEL : 86.9 ft bgs, 83.39 ft bgs
START : 4/23/2012
END : 5/5/2012
LOGGER : C. Kamali

| DEPTH BELOW GROUND SURFACE (ft) | CORE INTERVAL LOGGED (ft) | SAMPLE TYPE FOR ANALYSIS | ENVIRONMENTAL DATA (PID = ppm) | GRAPHIC LOG | SOIL DESCRIPTION<br>SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY | COMMENTS<br>DEPTH OF CASING, DRILLING DETAILS, INSTRUMENTATION | WELL GRAPHIC | ELECTRIC LOG (ohms)<br>Gamma Resistivity<br>25 50 75 100 |
|---|---|---|---|---|---|---|---|---|
| 195 | | | PID = 0.5 | | **SILTY SAND (SM)**<br>olive brown (2.5Y 4/4), wet, 75% fine sand, 25% nonplastic fines, trace mica | | | |
| 200 | 200.0 | HP | | | **POORLY GRADED SAND WITH SILT (SP-SM)**<br>dark greenish gray (10Y 4/1), wet, 90% fine sand, 10% nonplastic fines, trace fine mica, 6" thick zone of clay with gravel of silicified material at 201.0' bgs (fault gauge?) | Y8C15, hydropunch groundwater sample | | |
| 205 | | SOIL | | | | MW-32-204, soil sample for TOC | | |
| 210 | 210.0 | HP | PID = 0.0 | | **POORLY GRADED SAND (SP)**<br>light olive brown (2.5Y 5/3), wet, 100% fine sand, trace coarse sand, trace mica | Y8C18, hydropunch groundwater sample | | |
| | | | | | **WELL GRADED SAND (SW)**<br>dark greenish gray (10Y 4/1), wet, 70% medium sand, 20% coarse sand, 10% fine sand, trace mica | | | |
| | | SOIL | | | | MW-32-213, soil sample for TOC | | |
| 215 | | | | | | | | |
| | 210.0 | | | | **FAT CLAY (CH)**<br>greenish gray (5GY 5/1), moist, 100% fines, high | | | |

SOIL BORING LOG OMEGA; DRAFT CH2M GEOTECH_12.GLB; 386743_060412.GPJ; CH2M GEOTECH_12.GDT; 7/13/12

| PROJECT NUMBER: | BORING NUMBER: | |
|---|---|---|
| 386743.FI.02 | MW-32 | SHEET 10 OF 11 |

CH2MHILL®

# Soil Boring Log

PROJECT : Omega Chemical Corporation
LOCATION : Brink Avenue and Pluton Street

ELEVATION : 117.1 ft msl (ground surface) NAVD 88
DRILLING CONTRACTOR AND DRILL RIG : Cascade Drilling, L.P., Rotosonic

COORDINATES : N 1796526.14, E 6537526.08 NAD 83
DRILLING METHOD AND EQUIPMENT : 6"/7"/8"/9.625" Casings

WATER LEVEL : 86.9 ft bgs, 83.39 ft bgs
START : 4/23/2012
END : 5/5/2012
LOGGER : C. Kamali

| DEPTH BELOW GROUND SURFACE (ft) | CORE INTERVAL LOGGED (ft) | SAMPLE TYPE FOR ANALYSIS | ENVIRONMENTAL DATA (PID = ppm) | GRAPHIC LOG | SOIL DESCRIPTION<br>SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY | COMMENTS<br>DEPTH OF CASING, DRILLING DETAILS, INSTRUMENTATION | WELL GRAPHIC | ELECTRIC LOG (ohms)<br>Gamma / Resistivity<br>25 50 75 100 |
|---|---|---|---|---|---|---|---|---|
| | | SOIL | | | plasticity | MW-32-216, soil sample for TOC | | |
| | | | | | **SILT WITH SAND (ML)**<br>greenish gray (10Y 5/1), wet, 80% fines, 20% fine sand, trace fine mica | | | |
| 220 | 220.0 | HP | PID = 0.1 | | **SILTY SAND (SM)**<br>light olive brown (2.5Y 5/3), wet, 70% fine sand, 30% fines, trace fine mica | Y8C19, hydropunch groundwater sample | | |
| | | | | | **SILT WITH SAND (ML)**<br>dark greenish gray (10Y 4/1), wet, 75% fines, 25% fine sand as thin lenses, low plasticity | | | |
| 225 | | | | | **SILTY SAND (SM)**<br>dark greenish gray (10Y 4/1), wet, 70% fine sand, 30% fines, trace fine mica | | | |
| | | | | | **POORLY GRADED SAND (SP)**<br>light brownish gray (2.5Y 6/2), wet, 60% medium sand, 40% fine sand, trace coarse sand, trace mica | | | |
| | | SOIL | | | | MW-32-229, soil sample for TOC | | |
| 230 | 230.0 | HP | | | | Y8C20, hydropunch groundwater sample | | |
| | | | PID = 31.0 | | **SILT WITH SAND (ML)**<br>dark greenish gray (10GY 4/1), wet, 80% fines, 20% fine sand as thin lenses, nonplastic | | | |
| | | | | | **POORLY GRADED SAND (SP)**<br>dark greenish gray (10Y 4/1), wet, 95% fine sand, 5% fines, trace fine mica | | | |
| 235 | | | | | dark greenish gray (5GY 4/1), wet, 70% medium sand, 30% fine sand, trace coarse sand, trace mica | | | |
| 240 | 240.0 | | PID = 0.0 | | | | | |

CH2MHILL®

| PROJECT NUMBER: | BORING NUMBER: | |
|---|---|---|
| 386743.FI.02 | MW-32 | SHEET 11 OF 11 |

# Soil Boring Log

PROJECT : Omega Chemical Corporation
LOCATION : Brink Avenue and Pluton Street

ELEVATION : 117.1 ft msl (ground surface) NAVD 88
DRILLING CONTRACTOR AND DRILL RIG : Cascade Drilling, L.P., Rotosonic

COORDINATES : N 1796526.14, E 6537526.08 NAD 83
DRILLING METHOD AND EQUIPMENT : 6"/7"/8"/9.625" Casings

WATER LEVEL : 86.9 ft bgs, 83.39 ft bgs
START : 4/23/2012
END : 5/5/2012
LOGGER : C. Kamali

| DEPTH BELOW GROUND SURFACE (ft) | CORE INTERVAL LOGGED (ft) | SAMPLE TYPE FOR ANALYSIS | ENVIRONMENTAL DATA (PID = ppm) | GRAPHIC LOG | SOIL DESCRIPTION<br>SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY | COMMENTS<br>DEPTH OF CASING, DRILLING DETAILS, INSTRUMENTATION | WELL GRAPHIC | ELECTRIC LOG (ohms)<br>Gamma / Resistivity<br>25 50 75 100 |
|---|---|---|---|---|---|---|---|---|
| | | HP | | | | Y8C21, hydropunch groundwater sample | | |
| | | | | | greenish gray (10Y 5/1), 70% medium sand, 30% fine sand, trace mica | | | |
| 245 | | | PID = 0.0 | | light brownish gray (2.5Y 6/2), wet, 50% medium sand, 40% coarse sand, 10% fine to coarse gravel of quartz, up to 1", subrounded, trace mica | | | |
| 250 | | HP | | | | Y8C22, hydropunch groundwater sample | | |
| | | | | | Boring terminated at 250.0 ft bgs. | | | |
| 255 | | | | | | | | |
| 260 | | | | | | | | |

**Well Construction Diagram Symbols**

- Water level in monitoring well
- 3" Sch. 80 PVC 0.02" slotted screen and #3 filter sand
- # 30 transition sand
- Bentonite pellets
- Cement-bentonite grout
- Concrete
- Slough

**Notes:**

1) Hydropunch groundwater samples collected at 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, and 250 feet bgs.

2) Soil samples collected at 100, 115, 128, 143, 161, 182, 204, 213, 216 and 229 feet bgs.

3) Borehole diameter is 9.625 inches from 0 to 100 feet bgs, 8 inches from 100 to 190 feet bgs, and 7 inches from 190 to 250 feet bgs.

4) 1-inch nested piezometer installed in annulus of MW-32 from 80 to 100 ft bgs.

SOIL BORING LOG OMEGA; DRAFT CH2M GEOTECH_12.GLB; 386743_060412.GPJ; CH2M GEOTECH_12.GDT; 7/13/12


MW-32
10-12'
04.23.2012 11:37


MW-32
12-15'
28
04.23.2012 11:38


MW-32
15-18'
04.23.2012 11:38


MW-32
18-20'
04.23.2012 11:39


MW-32
20-23'
04.23.2012 11:39

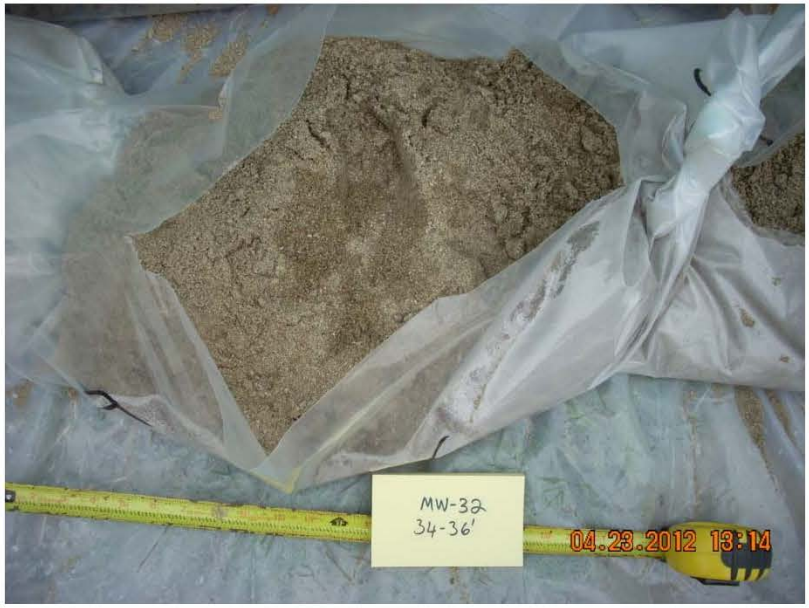

MW-32
23-25'
04.23.2012 11:40


MW-32
25-28'
04.23.2012 11:40


MW-32
28-30'
04.23.2012 12:55


MW-32
30-32'
04.23.2012 12:55


MW-32
32-34'
04.23.2012 12:55


MW-32
34-36'
04.23.2012 13:14


MW-32
36-38'
04.23.2012 13:14


MW-32
38-40'
04.23.2012 13:14


MW-32
40-42'
04.23.2012 14:15


MW-32
42-44'
04.23.2012 14:15


MW-32
44-46'
04.23.2012 14:16


MW-32
46-48'
04.23.2012 14:16


MW-32
48-50'
04.23.2012 14:16


MW-32
50-52'
04.23.2012 14:17

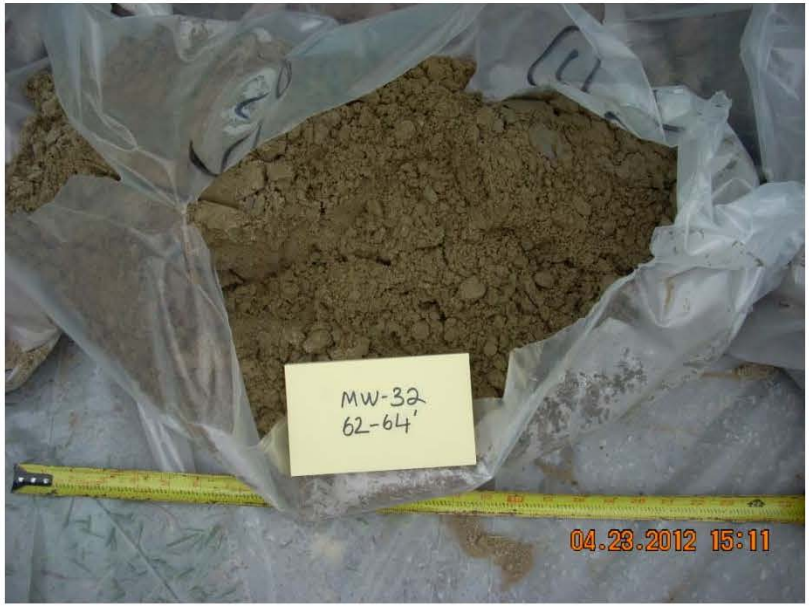

MW-32
52-54'
04.23.2012 14:18


MW-32
54-56'
04.23.2012 14:19


MW-32
56-58'
04.23.2012 14:19


MW-32
58-60'
04.23.2012 14:53


MW-32
60-62'
04.23.2012 14:53


MW-32
62-64'
04.23.2012 15:11


MW-32
64-66'
04.23.2012 15:12


MW-32
66-68'
04.23.2012 15:12


MW-32
68-70'
04.23.2012 15:12


MW-32
70-72'
04.23.2012 15:21


MW-32
72-74'
04.23.2012 15:38


MW-32
74-76'
04.23.2012 15:38


MW-32
76-78'
04.23.2012 15:46


MW-32
78-80'
04.23.2012 15:47


MW-32
80-82'
04.23.2012 15:47


MW-32
82-84'
04.24.2012 08:47


MW-32
84-86'
04.24.2012 08:48


MW-32
86-88'
04.24.2012 08:48


MW-32
88-90'
04.24.2012 08:48


MW-32
90-92'
04.24.2012 09:25


MW-32
92-94'
04.24.2012 09:26


MW-32
94-96'
04.24.2012 09:27


MW-32
96-98'
04.24.2012 09:27


MW-32
98-100'
04.24.2012 09:27


MW-32
100-102'
04.24.2012 09:28


MW-32
102-104'
04.24.2012 10:11


MW-32
104-106'
04.24.2012 10:11


MW-32
106-108'
04.24.2012 10:11


MW-32
108-110'
04.24.2012 10:12


MW-32
110 - 112'
04.24.2012 14:14


MW-32
112 - 115'
04.24.2012 14:14


MW-32
115 - 117'
04.24.2012 14:15


MW-32
117-120'
04.24.2012 14:15


MW-32
117-120'
04.24.2012 14:16


MW-32
120-122'
04.25.2012 08:50


MW-32
122-125'
04.25.2012 08:50


MW-32
125-127'
04.25.2012 08:51


MW-32
127-130'
04.25.2012 08:52


MW-32
130-132'
04.25.2012 14:14


MW-32
132-135'
04.25.2012 14:15


MW-32
132-135'
04.25.2012 14:15


MW-32
135-137'
04.25.2012 14:15


MW-32
137-140'
04.25.2012 14:16


MW-32
137-140'
04.25.2012 14:16


MW-32
140-142'
04.26.2012 09:11


MW-32
142-145'
04.26.2012 09:12


MW-32
145-147'
04.26.2012 09:12


MW-32
147-150'
04.26.2012 09:13


MW-32
147-150'
04.26.2012 09:15


MW-32
147-150'
04.26.2012 09:15


MW-32
150-152'
04.26.2012 11:07


MW-32
152-155'
04.26.2012 11:08


MW-32
152-155'
04.26.2012 11:08


MW-32
155-157'
04.26.2012 11:08


MW-32
157-160'
04.26.2012 11:09


MW-32
157-160'
04.26.2012 11:09


MW-32
160-162'
04.26.2012 11:50


MW-32
162-165'
04.26.2012 11:51


MW-32
162-165'
04.26.2012 11:51


MW-32
165-167'
04.26.2012 11:52


MW-32
167-170'
04.26.2012 11:52


MW-32
167-170'
04.26.2012 11:52


MW-32
170-172'
04.26.2012 13:25


MW-32
172-175'
04.26.2012 13:26


MW-32
172-175'
04.26.2012 13:26


MW-32
175-177'
04.26.2012 13:27


MW-32
177-180'
04.26.2012 13:27


MW-32
177-180'
04.26.2012 13:27


MW-32
180-182'
04.26.2012 15:24


MW-32
182-185'
04.26.2012 15:25


MW-32
182-185'
04.26.2012 15:25


MW-32
185-187'
04.26.2012 15:26


04.26.2012 15:26


MW-32
187-190
04.26.2012 15:27


MW-32
190-192'
04.27.2012 08:59


MW-32
192-195'
04.27.2012 09:00


MW-32
195-197
04.27.2012 09:00


MW-32
197-200'
04.27.2012 09:01


MW-32
200-202'
04.27.2012 11:29


MW-32
202-205'
04.27.2012 11:30


MW-32
202-205'
04.27.2012 11:30


MW-32
202-205'
04.27.2012 11:30


MW-32
205-207'
04.27.2012 11:30


MW-32
207-210'
04.27.2012 11:31


MW-32
207-210'
04.27.2012 11:31


MW-32
210-213'
04.27.2012 15:23


MW-32
213-215'
04.27.2012 15:23


MW-32
215-217'
04.27.2012 15:24


MW-32
217-220'
04.27.2012 15:26


MW-32
220-222'
04.30.2012 09:49


MW-32
222-225'
04.30.2012 09:50


MW-32
225-227'
04.30.2012 09:50


MW-32
227-230'
04.30.2012 09:51


MW-32
227-230'
04.30.2012 09:51


MW-32
230-232'
04.30.2012 11:31


MW-32
232-235'
04.30.2012 11:31


MW-32
235-237
04.30.2012 11:31


MW-32
237-240'
04.30.2012 11:32


MW-32
240-242'
04.30.2012 14:42


MW-32
242-245'
04.30.2012 14:43


MW-32
245-247'
04.30.2012 14:43


MW-32
247-250'
04.30.2012 14:43


MW-32
247-250'
04.30.2012 14:43

# Appendix C
# Well Construction Diagram

CH2MHILL

| PROJECT NUMBER: | MONITORING WELL: |
|---|---|
| 386743.FI.02 | MW-32 |

# *Well Completion Diagram*

PROJECT : Omega Chemical Corporation

LOCATION : Brink Avenue and Pluton Street

ELEVATION : 117.1 ft msl (ground surface)

DRILLING CONTRACTOR AND DRILL RIG : Cascade Drilling, L.P., Rotosonic

COORDINATES : N 1796526.14, E 6537526.08 NAD 83

DRILLING METHOD AND EQUIPMENT : 6"/7"/8"/9.625" Casings

WATER LEVEL : 86.9 ft bgs, 83.39 ft bgs

START : 4/23/2012

END : 5/5/2012

ENGINEER : C. Kamali

**12" EMCO well box in 3' x 3' concrete box**

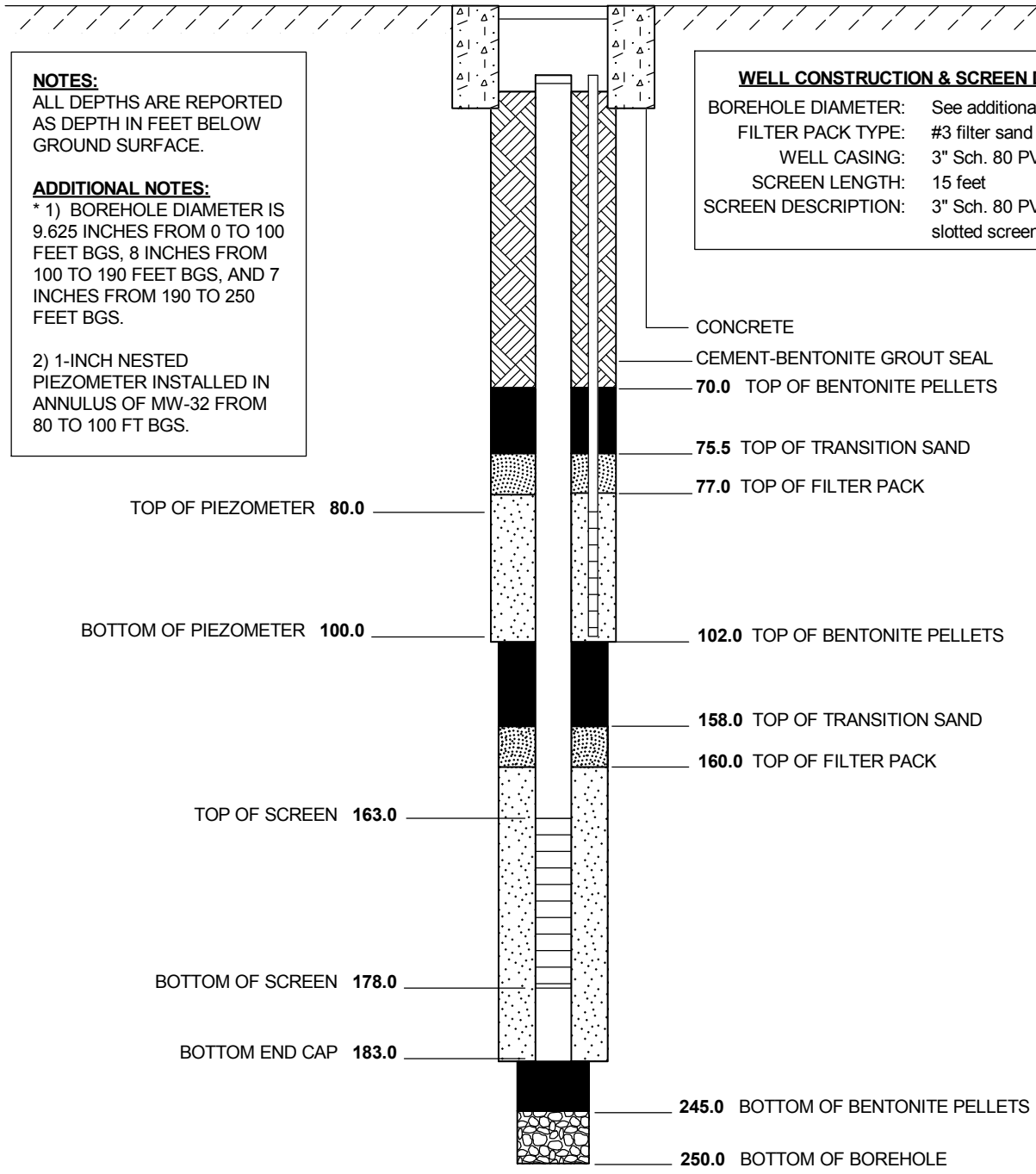
**NOTES:**
ALL DEPTHS ARE REPORTED AS DEPTH IN FEET BELOW GROUND SURFACE.

**ADDITIONAL NOTES:**
* 1) BOREHOLE DIAMETER IS 9.625 INCHES FROM 0 TO 100 FEET BGS, 8 INCHES FROM 100 TO 190 FEET BGS, AND 7 INCHES FROM 190 TO 250 FEET BGS.

2) 1-INCH NESTED PIEZOMETER INSTALLED IN ANNULUS OF MW-32 FROM 80 TO 100 FT BGS.

**WELL CONSTRUCTION & SCREEN DETAILS**

| | |
|---|---|
| BOREHOLE DIAMETER: | See additional notes |
| FILTER PACK TYPE: | #3 filter sand |
| WELL CASING: | 3" Sch. 80 PVC |
| SCREEN LENGTH: | 15 feet |
| SCREEN DESCRIPTION: | 3" Sch. 80 PVC 0.02" slotted screen |




WELL DIAGRAM IS NOT TO SCALE

WELL COMPLETION DIAGRAM UNCODED; DRAFT CH2M GEOTECH_12.GLB; 386743_060412.GPJ; CH2M GEOTECH_12.GDT; 7/13/12

# Appendix D
# Well Survey Report
# (on CD only)

# Appendix E
# Downhole Geophysical Log
# (on CD only)

# Appendix F
# Well Development Log
# (on CD only)

# Appendix G
# Well Pumping Test Log
# (on CD only)

# Appendix H
# Chain of Custody Forms
# (on CD only)

# Appendix I
# Laboratory Reports
# (on CD only)

# Appendix J
# Data Validation
# (on CD only)

# Appendix K
# Pumping Test Analysis

**Appendix K**

Aquifer Parameter Comparison from MW32 Pumping Test Data Analyses

*Omega Chemical Corporation Superfund Site*

| **Method** | **T $ft^2/d$** | **b ft** | **$K_r$ ft/d** | **$K_r$ ft/min** | **S** | **$S_s$ 1/ft** |
|---|---|---|---|---|---|---|
| Moench method in AQTESOLV | 5753.4 | 30 | 191.78 | 1.33E-01 | 0.1 | 3.33E-03 |
| GWF | | | 135.792 | 9.43E-02 | | 6.73E-05 |
| **Relative Percent Difference (RPD)** | | | | **9%** | | **48%** |

Notes:

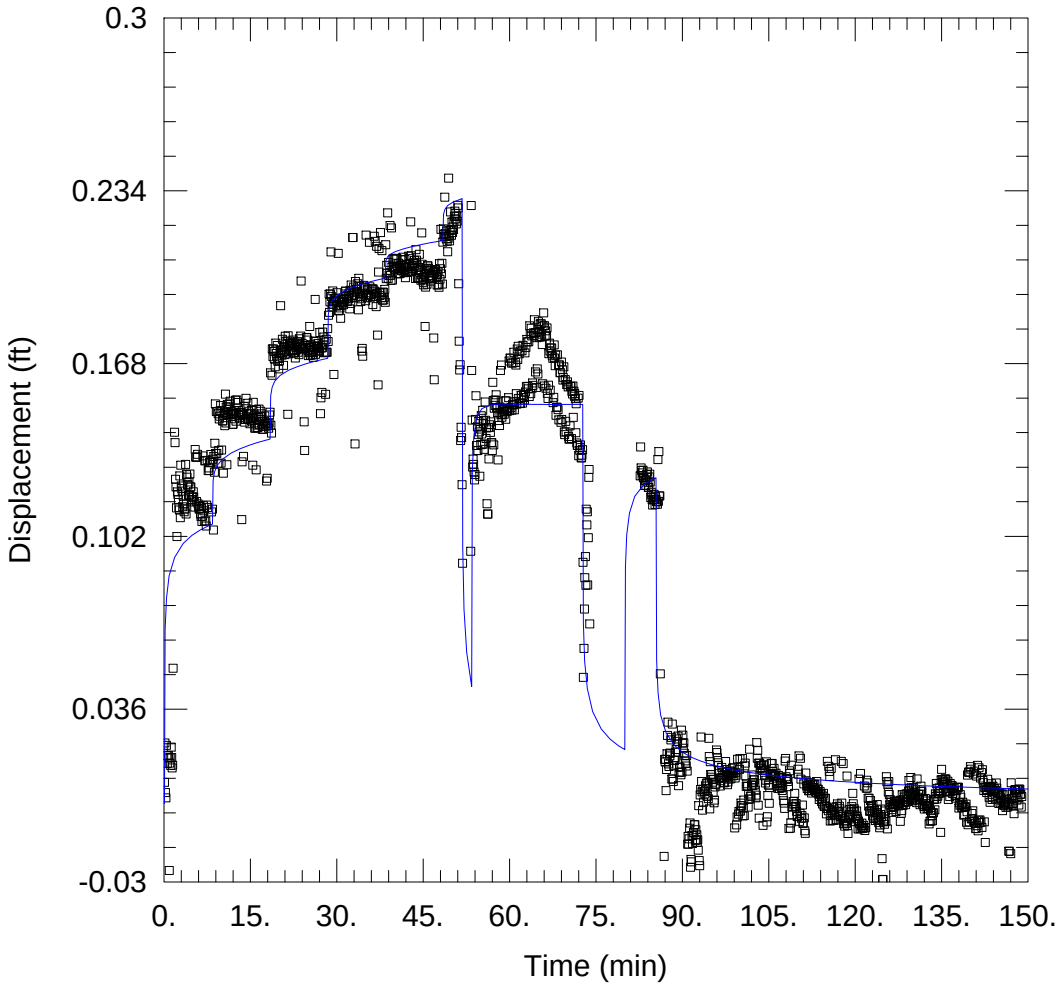
T = Transmissivity

b = Aquifer thickness of sandy unit screened by MW32

$K_r$ = Horizontal hydraulic conductivity

S = Storativity

$S_s$ = Specific storage




## WELL TEST ANALYSIS

Data Set: C:\projects\Omega\MW32\Aqtesolv\MW-32 rev1.aqt
Date: 06/15/12 Time: 17:21:37

## PROJECT INFORMATION

Company: CH2M HILL
Client: EPA
Location: Norwalk, CA
Test Well: MW-32

## AQUIFER DATA

Saturated Thickness: 30. ft Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA

Pumping Wells

| Well Name | X (ft) | Y (ft) |
|---|---|---|
| MW-32 | 0 | 0 |

Observation Wells

| Well Name | X (ft) | Y (ft) |
|---|---|---|
| ▫ MW-32 | 0 | 0 |

## SOLUTION

Aquifer Model: Unconfined Solution Method: Moench

T = 5753.4 $ft^2$/day
Sy = 1.0E-6
Sw = 0.
r(c) = 0.125 ft

S = 0.1
ß = 1.736E-6
r(w) = 0.125 ft
alpha = 1.0E+30 $min^{-1}$

GWFi results for input file: mw32_1

| | | |
|---|---|---|
| Noise level | RMS | 0.01 |
| Misfit | RMS | 0.018707 |
| Residual | RSS | 3.50E+00 |

Inversion run time: 01:30:31

Parameter Estimates:

| Name | Location | Value | stdv | stdv% | Composite Mean Sensitivity | | min | max | |
|---|---|---|---|---|---|---|---|---|---|
| Kr | aquifer | 9.43E-02 | 1.11E-06 | 0.001 | 1.28E+02 | -9.38E-01 | 1.00E-06 | 1 | 136 |
| Ss | aquifer | 6.73E-05 | 1.21E-08 | 0.018 | 1.18E+04 | -8.48E+01 | 1.00E-06 | 0.001 | |

Parameter Correlation Matrix:

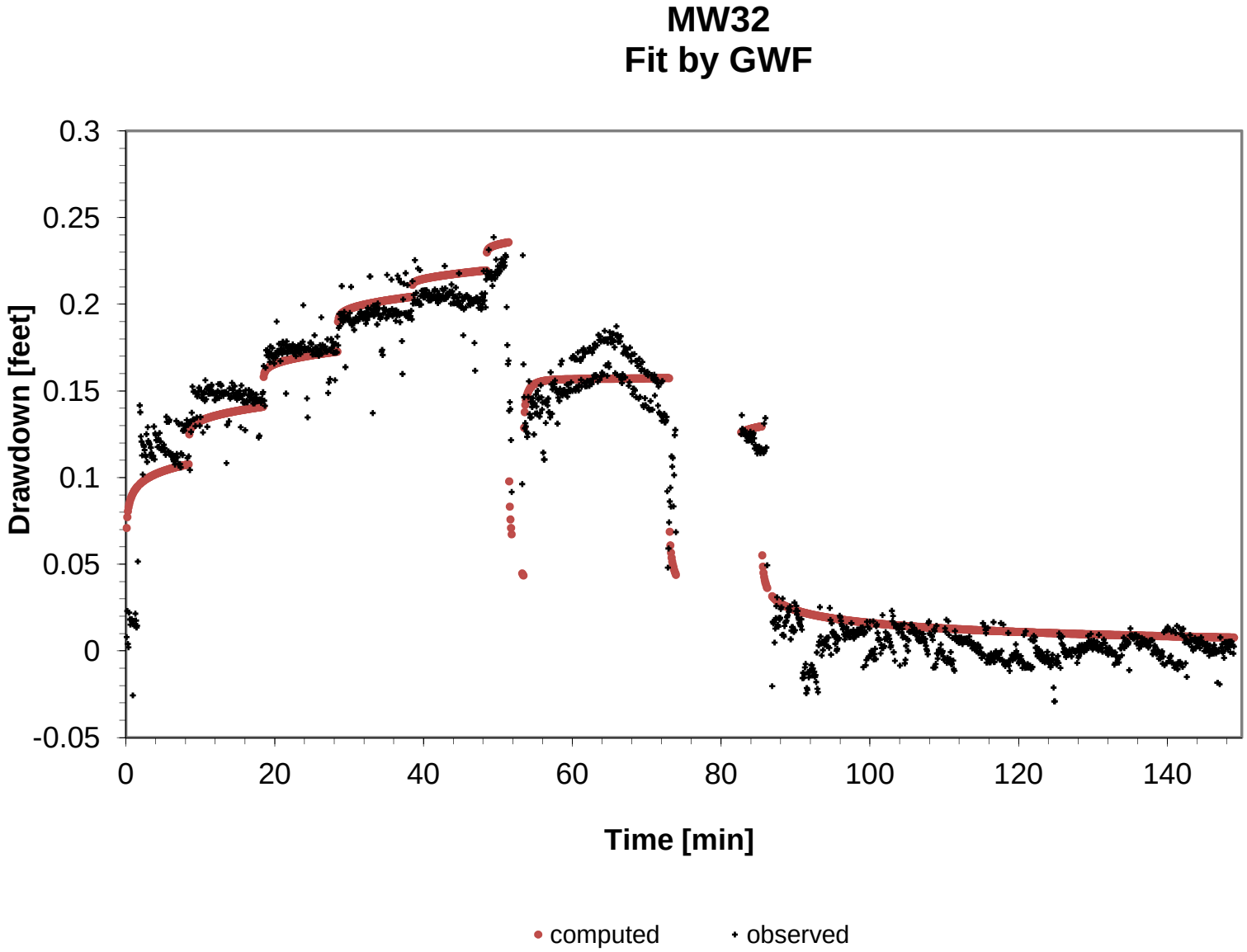
| | Kr | Ss |
|---|---|---|
| Kr | 1 | -0.99685 |
| Ss | -0.99685 | 1 |

Parameter Covariance Matrix:

| | Kr | Ss |
|---|---|---|
| Kr | 1.23E-12 | -1.34E-14 |
| Ss | -1.34E-14 | 1.46E-16 |

Parameter Resolution Matrix:

| | Kr | Ss |
|---|---|---|
| Kr | 1.00E+00 | 1.24E-12 |
| Ss | 1.42E-13 | 1.00E+00 |


MW32
Fit by GWF
Drawdown [feet]
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
20
40
60
80
100
120
140
Time [min]
computed
observed

# Appendix L
# IDW Shipment Manifest
# (on CD only)